PERIODICAL GENERAL LIBRARY UNIV. OF MICH.
JUN 23 1924

The ELECTRICAL REVIEW

FOUNDED 1872

VOL. XCIV. No. 2429 | [All Rights Reserved.] | JUNE 13, 1924. | [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] | PRICE SIXPENCE.

LITHOLITE INSULATORS, Ltd.
55–57, Hackney Grove, London, E. 8.
'Phone and Telegrams: Dalston, 592, London.
FIREPROOF AND OTHER GRADES.
ESTABLISHED OVER 20 YEARS.

The Acme Production Co., Ltd., *Electrical Specialities Manufacturers.* — **Automatic Flashers** — Britannia Works, Rolfe St. and Engine St., SMETHWICK, BIRMINGHAM.

WRIGHT Tel.: Motor.
A.C. and D.C. **MOTORS.**
WRIGHT MOTORS, Ltd., HALIFAX.

RESISTANCE MATERIALS
Asbestos Woven Resistance Grids. Resistance Cord. Resistance Wires & Tapes.
CRESSALL MANUFACTURING CO.,
Staniforth Street, BIRMINGHAM.
Telegrams: "Ohmic, Birmingham." Telephone: Central 3463.

LANTERN REFLECTOR WATERTIGHT AND SHIPS' FITTINGS.
E.L.E.C., LTD.
with Anti-Vibrator Discs.
ENGINEERING & LIGHTING EQUIPMENT CO., LTD.,
Sphere Works, St. Albans, Herts.

RHEOSTATS AND—
See next announcement.
ISENTHAL & CO., LTD.,
Denzil Works, Willesden, N.W. 10.

SWITCHGEAR.
ERNEST F. MOY, LTD.,
Manufacturing Electrical Engineers and Government Contractors,
GREENLAND PLACE, CAMDEN TOWN, LONDON.

MICA PLATES for WIRELESS CONDENSERS and MAGNETOS. RINGS for HIGH-TENSION, X-RAY and ELECTRICAL INSTRUMENTS. DIAPHRAGMS for SOUND BOXES and LOUD SPEAKERS. COMMUTATOR Segments, V-RINGS, Washers, Tubes, &c.
MICA AND MICANITE INSULATION
TAYLOR & PETTERS, Ltd., 40, Hatton Garden.
'Phone: Holborn 2981. E.C. 1.

JULIUS SAX
Specialists in
BELLS 1855.
and
Wall Plugs.
24a, High Street, Bloomsbury, W.C.2.

CHURTON
SINGLE and POLYPHASE
MOTORS.
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS

ELECTRIC MOTOR REPAIRS
ARMATURES REWOUND.
H. DUNN & SON,
Newington Causeway,
Tel.: Hop. 1167. LONDON, S.E. 1.

"EMPIRE"
— S & C FUSES —
Up to 132,000 Volts.
Ave. 14 British Empire EXHIBITION. Bay 8
ELECTRIC CONTROL, Ltd., GLASGOW.

PORCELAIN
BAKELIZED BOARD AND PAPER.
Send your enquiries to:—
HARWELL, Ltd., *Insulation Dept.*,
28, John St., Theobald's Rd., London, W.C. 1.
'Phones: Museum 5422 and 5423. Telegraphic Address: "Arwelidite, Holb, London."

WESTERN-ELECTRIC
COMPANY, LIMITED,
Connaught House, Aldwych, W.C. 2.
Works: NORTH WOOLWICH, LONDON, E.
TELEPHONES & CABLES.
See Advertisement this week, Sup. 33.

Cutting
Electric Motors.
CUTTING BROS., LTD., STAMFORD.
Telegrams: Cutting, Stamford. Tel. No. 12.

WHITE
Electrical Instrument Co., Ltd.
2, 4 & 6, GLOUCESTER ST., CLERKENWELL, LONDON, E.C. 1.
Wire, Voltograph, London. 'Phone: Clerkenwell 6399.

Electrical
INSULATING MATERIALS
and
WIRELESS COMPONENTS EBONITE
SPICERS, LIMITED (Insulation Dept.),
19, New Bridge Street, London, E.C. 4.
'Grams: Nyloping, Lud, London. 'Phones: City 6257, Ex 49.
See our Advt. on page xxii of this issue

INSULATING
- - BEADS - -
Immediate Delivery.
HOLDER-HARRIDEN LTD., 1-2, Chiswell St., London, E.C.

The Opportunity.
See Sup. 9.

DERMATINE
JOINTING
PUMP VALVES
HOSE & TUBING
BELTING
Dermatine Co., Ltd., Neate St., London, S.E. 5.

SHUNT REGULATORS.
MOTOR STARTERS and all classes of Resistance Work.
STAR DELTA SWITCHES.
THE SOLENOID REGULATOR CO.,
HIGHGATE SQUARE, CAMP HILL,
Telephone: Midland 532 BIRMINGHAM. Telegrams: Solenoid, Birmingham.

WEIGHT REDUCTION means FREIGHT REDUCTION. Hence
ALUMINIUM
The British Aluminium Co., Ltd., 109, Queen Victoria St., London.

MAVOR & COULSON, Ltd.,
GLASGOW.
MOTORS, DYNAMOS, SWITCHGEAR.

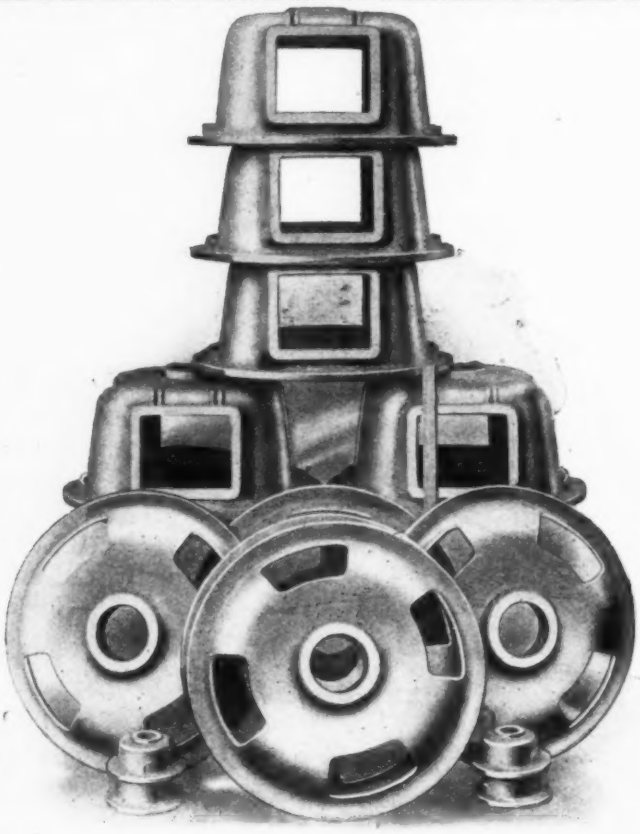
CONVEYORS & ELEVATORS.
Power Station, Coal & Ash Handling Plants.
FRASER & CHALMERS ENGINEERING WORKS,
(*Proprietors*: The General Electric Co., Ltd.)
ERITH, KENT. *London Office:* Magnet House, Kingsway, W.C. 2.
Associated with Robins Conveying Belt Co., of U.S.A.

CARSON'S
27, UPPER THAMES ST., E.C. 4.
'Grams: "Irishism Cent. London." 'Phone: Central 6897.
INSULATORS.

FULLER'S UNITED ELECTRIC WORKS, LIMITED.
MANUFACTURERS OF
ACCUMULATORS BATTERIES
WIRES & CABLES EBONITE
WIRELESS APPARATUS CARBON BLACK
Head Office:
(General Sales Offices and Works).
WOODLAND WORKS, GROVE ROAD,
CHADWELL HEATH, ESSEX.

INGLEBY & Co., Ltd.
BEESTON.
LEEDS.
ELECTRIC MOTORS.

Advertisement Index, see page xl. *Official Notices, see Sup. 34.*



MOTOR END BRACKETS IN WILMIL ALLOY FOR H.M. ADMIRALTY.

Malleable
ALUMINIUM CASTINGS.

A featherweight substitute for brass or iron—cheaper than the former in first cost – more economical than the latter wherever parts must be accelerated.

NON-MAGNETIC.

NON-CORROSIVE.

LIGHTER *than* ALUMINIUM.

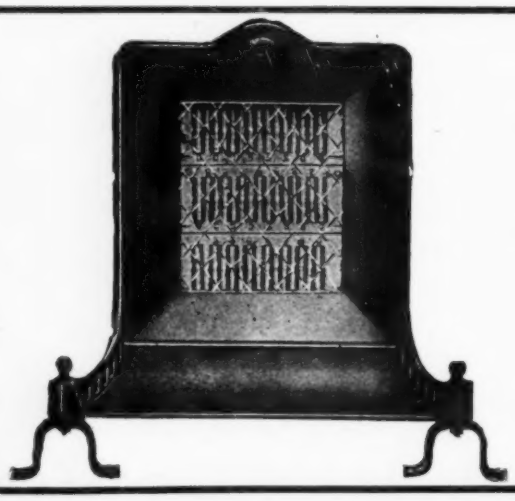
STRONGER *than* CAST-IRON.

WILLIAM MILLS, LTD.,
Grove Street,
BIRMINGHAM.

MICA & MICANITE

INSULATORS FOR EVERY DESCRIPTION OF ELECTRICAL WORK.
We supply to The Trade Three-quarters of a Million Mica Condenser Plates weekly.
SUPERFINE "MICAYLOR" DIAPHRAGMS FOR SOUND BOXES.
CUTTING, GAUGING AND MACHINING OUR SPECIALITY.

'PHONE—2381 HOLBORN,
TELEGRAMS—"MICAYLOR, LONDON."
TAYLOR & PETTERS, LTD.,
40, HATTON GARDEN,
LONDON, E.C. 1.
(The Oldest Established Mica House in the country.)
AND ALL BRITISH.



THE
ARORA ELECTRIC FIRE
Has given universal satisfaction.

WHY? Because OUR patented Element is of HEAVY SECTION and has LOW Current Density, yet it glows at a HIGH TEMPERATURE

Low Price, Robust, Cheery, Economical.

Write for List E (Fires & Cookers) to Sole Manufacturers.

THE ARORA CO., Loughborough.
(Proprietors: MESSENGER & Co., LTD.)

SEND IT TO—

REPAIRS WINDS DESIGNS COLLINS ELEC. LTD.,

115, CLERKENWELL ROAD, LONDON, E.C. 1. TEL: HOLBORN 212.

UM
S.

te for
an the
e eco-
wher-
rated.

NIUM.

IRON.

L^TD.,

AM.

ORN,
LONDON."
S, L^TD.,
DEN,
, E.C.1.
the country.)
ISH.

FIRE
n.
CTION and
PERATURE
mical.
facturers.
ough.

TD.,

The

Electrical Review

VOL. XCIV. JUNE 13, 1924. No. 2,429.

THE OLDEST ELECTRICAL PAPER. ESTABLISHED 1872.

Published every FRIDAY, Price 6d.

Chairman: H. ALABASTER.

Technical Editor: A. H. ALLEN, M.I.E.E. *Joint Managing Directors:* G. H. ALABASTER. E. A. GATEHOUSE, M.I.E.E. A.M.INST.C.E. *Commercial Editor:* A. H. BRIDGE.

Manager and Secretary: E. S. MIDDLETON.

OFFICE: 4, LUDGATE HILL, LONDON, E.C.4.

Telegraphic Address: "AGEEKAY, CENT., LONDON," Code, A B C. Telephone Nos.: Central 8260 and 8261.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum. Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "Midland Bank, Newgate Street Branch."

LIST OF FOREIGN AGENTS (see first page "Official Notices").

Contents:

	PAGE
The Electrical Situation in Russia...	949
The Critic on the Hearth	950
Group Drive in Clothing Factories	951
Municipal Contracts	951
The I.M.E.A. Convention	951
The International Conference on High-pressure Lines	951
Power Transmission Lines	951
The Importance of Big Showrooms, by L. L. Robinson (*Illus.*)	952
Working Records for Large Generating Sets (*Illus.*)	953
The Dewpoint Temperature of Gases from Combustion, by J. N. Waite (*Illus.*)	954
The Loughborough Electricity Works (*Illus.*)	956
The "Morganite" Resistor (*Illus.*)...	958
Electricity Supply at Shanghai (*Illus.*)	959
Reviews	960
Business Notes	961
Lighting and Power Notes	964
Tramway and Railway Notes	965
Telegraph and Telephone Notes	966
Radio Notes	966
Contracts Open and Closed	966
Some of the Exhibits at Wembley (*Illus.*)	967
Forthcoming Events	971
Notes	971
Institution Notes	973
Our Personal Column...	974
New Companies Registered	975
Official Returns of Electrical Companies	975
City Notes	975
Stocks and Shares	977
Market Quotations for Chemicals and Metals	978
Power Transmission Lines—II, by William T. Taylor (*concluded*)	979
The London Electricity Supply Problem (*continued*)	981
Swiss Engineering in 1923	982
The Empire Mining and Metallurgical Congress ...	984
Birmingham Corporation Tenders	985
Ceylon's Electrical Imports	986
Parliamentary	986
Correspondence—	
Overload Protection by "Z"-connected Relays ...	986
Pulverised Coal	986
Legal	987
Published Specifications	988
Contractors' Column ... ... Advertisement page xxviii	

The Electrical Situation in Russia.

FOR several years past we have reported, for what it was worth, a fairly large percentage of the information that has reached us from various sources regarding the state of electrical affairs in Russia. We say "for what it was worth" because sometimes the reports received by us have been, if not contradictory, at any rate difficult to reconcile, while at others they have seemed to be so optimistic as to be open to suspicion as to their origin. In a third class lie the statements which lose all merit or usefulness by reason of obscurity, perhaps arising in the process of translation. The time has come, however, or at any rate that is our opinion, when we in the United Kingdom should devote increasingly serious attention to the electrical requirements of Russia. Before the war we again and again drew attention to the immensity of the market of Russia and Siberia for electrical goods—the surface of the ground having been but lightly scratched in isolated places. The way was open—it was regarded as the natural path—for electrical goods to pass from Germany across into the vast Russian territories that possessed such small electrical manufacturing facilities of their own and those mainly of German ownership or control. While the war was in progress and the fluctuations of feeling between this country, Russia and Germany, occurred according to the varying phases of the hostilities and to the patriotic or revolutionary tendencies of different years, Russian electrical and engineering authorities set forth their views on the situation and spoke of the inevitability of ultimate German industrial and trade partnership with the Russian people under whatsoever *régime* might come or go. British and other engineers came to this country and told their story of big electrical developments that were in contemplation and

of significant events that had taken place, from all of which one could only come to the conclusion that there was such an electrical opportunity in store as had seldom presented itself to any export manufacturing nation, but unfortunately that the time was hardly ripe for large action.

For some time past there has been a lull in Russian affairs—less turbulence, a weariness it may be with the long years of horror, tragedy, upheaval and restlessness; perhaps due to the coming of disillusionment; the waters of resentment and revenge have been found to flow out to an ocean of bitterness instead of to a land of new hope and sweetness; and instead of a new "system" of human and industrial relationship arising out of the ashes there may be a slowly growing recognition of the fact that for this very ordinary world with its very erratic and human temperament the satisfactory practical alternative has not yet been found. But the situation is still most obscure, and there is officially little disposition to give the assurances which are essential if there are to be guarantees of business security which are necessary for the renewal of international trade. The speech in May, by Kamenev, the vice-president of the Soviet Cabinet, is marked by a spirit of condescension which calls upon us if we "desire" to lend moneys to them to subordinate ourselves to the Courts, laws, and regulations which they have established. Much as we may desire to assist the return to financial and trade relations between ourselves and Russia, how can we expect it soon in presence of such an attitude or in such an atmosphere?

This is the more regrettable in the present situation in Russia when so many men in that land are anxious to see electrification accorded its proper place in the development of affairs in the interests of the people.

As we have recently recorded in these pages, certain British engineering and electrical companies who have been devoting attention to the potentialities of the Russian market for some time past have undertaken contracts, attended by considerable risks, but they cannot accept all the work that is presenting itself because it is unwise that they alone should load themselves up with risks beyond a certain limit. If the present British Government is favourable to Russia and at the same time desires to remove some of our own unemployment and maintain contented supplies of skilled labour in the United Kingdom, it should give heed to this position and seriously examine whether it cannot assist British electrical and engineering industry to secure more Russian contracts possibly along Trade Facilities lines if that course can be adopted without weakening the demand for the essentials to business security to be given by the Soviet authorities and without sacrificing vital principles in regard to pre-war debts.

Among our Russian information just to hand is a report regarding the constitution of a Russian electrical bank. It is reported that as contrasted with the opposition manifested by lower authorities to the establishment of an electrical bank, the Council of Labour and Defence and the Council of National Commissioners have now positively approved a scheme for the constitution of a bank for financing works of electrification, which is to be developed on the basis of the existing Electrocredit Company. It is considered that as a bank the institution will become associated with other banks and accept deposits and current accounts and in this way secure a large turnover of funds. It is also held in prospect that foreign capitalists will be attracted in the near future to participate in the financing of works of electrification. The statutes of the bank are already in course of preparation for submission to the directors of the Electrocredit Company and then to the responsible Government organisations for approval.

We are informed that the works in hand under the General Electrical Commissariat in the present financial year comprise the continuation of the construction of stations which were begun in the years 1919-22, these forming seven of the thirty regional stations which were contemplated in the original programme of electrification. These are the Volkhov hydro-electric station of a proposed capacity of 54,000 kW, which is to be completed in 1925; the Red October peat fuel station of 20,000 kW, which is to be fully equipped this year; the Kashirsk pit coal station in the southern part of the province of Moscow, and of a capacity of 44,000 kW, which is to be ready in 1926; the Schatur peat fuel station of 45,000 kW, which is to start in 1925; the Shterovsk pit coal station of 20,000 kW, which is to be complete in 1925; the Nijni Novgorod peat fuel station of 20,000 kW, which is to begin working in 1925; and the Kizelovsk pit coal station of 6,000 kW, which is to commence supply this year.

Besides these State subsidised stations of a regional nature, four other stations of a local character are in course of construction with Government subsidies, and also on the basis of grants from local budgets.

In addition, State funds are being devoted to the regularising of the work of electricity supply in Moscow, Leningrad, and Kharkoff, and to the unification of supply systems in industrial districts. The total expenditure on the works already carried out by the Soviet authorities and the works included in this year's programme is estimated at £10,000,000.

Although this sum is said not to appear to be very large by comparison with the needs of the country, it is pointed out that it represents 10 per cent. of the amount of the general scheme of electrification. The great question of the moment is said to be to prepare intending customers for supply from the regional stations.

A large expenditure will be required in the extension of the networks and the re-equipment of the industrial undertakings, which work has had to be postponed in the current year owing to the inadequacy of funds, but the matter is declared to be so important as not to permit of any further delay.

We place these facts before our readers as indicating that an important moment in Russian electrification has arrived. Outside assistance is necessary; shortage of funds is holding up important electrical work. There is little doubt that abundant financial co-operation from Britain and other countries would be forthcoming if reasonable guarantees of security could be given, and whoever can hasten the bringing about of that desirable state of affairs will do much toward placing at the disposal of Russia's vast population the services of electricity as a means of development and progress.

The Critic on the Hearth.

Two criticisms of the Electrical Contractors' Association—or shall we say one of the Association by a member, and one of the members by the Association?—appear in the current issue of the *Electrical Contractor*. To take the castigation of members first: this is soundly administered by the editor of the journal, which everybody may not know is the official organ of the Association. It had been resolved to hold an E.C.A. gathering at Wembley, and invitations were duly issued to members with the result that at the closing date there was a "totally—absurdly—inadequate response." The writer holds that this incident serves to illustrate "the astonishing apathy of members in answering official communications." "Not polite!" adds the writer and "amazingly unbusinesslike." He is even so inquisitive as to ask: "Do our members exhibit the same monumental indifference in connection with their ordinary business correspondence?" To the enterprising leaders in the movement such an indifference is "heartbreaking"—destroys "all enterprise and initiative"—reduces "us to an outlook of despair and drift." In sheer desperation the editor tears his hair as he still

further asks: "What on earth is the matter with us all?" What indeed! "Are we all dead—or merely fast asleep?" "Peradventure he sleepeth."

By what may be an interesting coincidence there appears a letter in the "Correspondence" section entitled "A Long Shout and No Performance," and signed "Progressive." The editor describes it as a vigorous outburst, and invites the opinion of members upon it. "Progressive" bluntly asks of what use the E.C.A. is to the industry. He describes the history of the Association "since the commencement some fifteen years years ago" (we thought it celebrated its twenty-first birthday two years ago?) as "one long shout and no performance." But "What could one expect for a subscription of three or four paltry guineas a year?" Whether one guinea is more "paltry" than another we have our doubts, but who can question whether "if there were 10,000 members, something could be done on such a subscription?" The great end that "Progressive," whoever he may be, desires is for the contractors "to get together upon business lines and run their Association as a business concern on a proper subscription which would enable it to tackle efficiently all the various abuses which render our trade profitless at present." And in the face of such an attack all that the editor of the official organ can do is to invite the opinion of members—before he indulges in comment!

Group Drive in Clothing Factories.

THE proprietor of a large textile "making-up" factory recently stated that a very great saving in power charges had resulted from the adoption of the group drive for sewing machines. In the modern clothing factory there are very few treadle machines, but in many of the older factories the line shaft is still retained which runs from end to end of the machine room, and is driven by an electric motor or a gas engine. In some factories every ten machines form a group, which is driven by a one horse-power motor. There is a short line shaft underneath the machine table, and the drive is usually effected by chains instead of belts, the diameters of the sprocket wheels regulating the speed of each machine. A great advantage of the low-powered motor driving a group of ten machines is that when anything goes wrong either with the motor or a machine, the production of the factory as a whole is not interfered with. In a factory where several hundreds of girls are employed it is not difficult to absorb the operators of a few machines that have been stopped. The stoppage, however, if it results from a motor fault, is of short duration, because a spare motor can be substituted for the defective one in a few minutes. We understand that in the factory above referred to there are nearly a hundred motors which have been running for about three years, and on very few occasions has there been even a partial dislocation of the organisation owing to motor trouble.

Municipal Contracts.

ON the whole, municipal authorities have been reasonable in their recent attitude towards foreign tenders for electrical equipment. The appeal of the unemployed for orders to be placed in the United Kingdom so that British public money would afford British workmen wages has not fallen upon deaf ears. But nobody, and least of all the manufacturers, can afford to ignore the fact that events in three more or less important cities or centres threaten to weaken the pro-British resolution. Whenever in leading local minds suspicions are aroused which, when passed on to the public, create an impression that a desire for supporting Home industries is being unfairly exploited, the cause of British employment is not assisted, nor is the future prosperity of our industries assured. Attacks of such a kind, upon however small a group of manufacturerers, can hardly be left unanswered. Silence feeds suspicion even when there may be little justification for it.

The I.M.E.A. Convention.

NEXT Monday the Incorporated Municipal Electrical Association will open its annual Convention at the ancient City of Chester, which, as its name implies, has been a walled town since Roman days, and possesses many features of interest to lovers of the antique, besides a most up-to-date extra-high-pressure electrical installation and hydro-electric plant which it owes to the energy and enterprise of the president of the Association, Mr. S. E. Britton, city electrical engineer. An admirable programme has been arranged, of which we recently published the main features—it holds the balance fairly between business and pleasure, and provides ample variety to suit all tastes. If the weather behaves decently, a very successful Convention should result.

In connection with the Convention there will be an exhibition of electric cooking and water-heating apparatus, on lines very similar to last year's, and a special lighting service display, arranged by E.D.A. with the co-operation of E.L.M.A., which is believed to be an exceptionally interesting demonstration, with certain elements of an unexpected nature. These are very valuable features of the Convention, and the latter especially should afford a powerful stimulus for the winter lighting campaign, which should be in full swing in a month or two. A daily demonstration of thrust-boring will be of interest to many engineers who have not previously had an opportunity of seeing this useful process, and the visit to the British Insulated and Helsby Cable factory will be a very popular item.

The I.M.E.A. wisely decided to hold its Convention in the usual way at a provincial centre, and to visit the British Empire Exhibition on a separate occasion later in the year. Many of the members, however, will doubtless be attracted to the World Power Congress, which follows it a fortnight later—and we can assure them that they cannot pay too many visits to Wembley, for it is impossible to exhaust the attractions of that most wonderful show.

The International Conference on High-pressure Lines.

WE understand that whilst a large number of orders have been received for the English edition of the report of the proceedings at the Conference of last November, the number still falls far short of that which would enable the secretary to issue an English translation. It is not to be believed that in the English-speaking countries of the world there are fewer than 1,200 engineers who would find this report of far greater value to them than the cost of it in cash (100 francs); those who have not yet subscribed are presumably not aware of the proposal, or have failed to realise the value of the work. As explained in our issue of March 7th, 1924, pp. 362 and 384, the contents of the report cover a very wide field and embody the experience of most eminent electrical engineers of all countries on overhead line construction for very high pressures and cognate subjects. The matter is of equal interest to residents in the United States and in the British Dominions and Colonies, and the help of our oversea contemporaries in drawing attention to it would doubtless be appreciated by the secretary, M. Tribot Laspière, whilst it would confer a benefit on many of their readers.

Power Transmission Lines.

IN the concluding portion of Mr. W. T. Taylor's second article, which appears in this issue, examples are given of the use of the chart which was reproduced in our last issue. When the construction of the chart is understood it will be found to be a valuable aid in the calculation of the quantities to which it relates, and a great time-saver. We therefore suggest that readers interested in this subject, which is rapidly growing in importance owing to the increasing use of overhead lines, should preserve the chart, or copy it on a larger scale, for use in their work. Other charts will be published in connection with the articles that are to follow.

D

The Importance of Big Showrooms.

By L. L. ROBINSON, M.I.E.E., M.Inst.C.E., Borough Electrical Engineer, Hackney.

I HAVE had bitter experience of showrooms and offices far too small for the business, where the kitchen and showroom frequently resemble a cross between a warehouse, packing shop, and showroom. This is no good; it is like looking at a good play from the wings and all proper perspective and atmosphere are lost. When you want to sell to a customer, you must have every device that skill can produce to surround him with the proper atmosphere. If you want him to spend a lot on the luxurious electrification of his home, the first thing to do is to make him *feel* luxurious.

I have just had a practical proof of this. A lady who has been into our so-called showroom and who has nibbled at the electric house idea for months without bitting, went the other day into the E.D.A. bungalow at Wembley. This settled her at once—she came straight back and asked us to quote for the complete electrification of her flat, including *cooking, heating, water heating, ironing, and sewing machine*—not a bad start.

Perhaps I can best describe my idea of what an electrical supply undertaking's showroom and offices should be like by referring to the plans which have recently been prepared by Mr. J. A. Bowden, F.S.Arc., for the new building for my undertaking. (Figs. 1, 2 and 3.)

The frontage extends about 100 ft. along one of the most important main streets in the area, the site being in the centre of gravity of the area and approachable from any point by many 'buses and tramcars. The elevation is of a striking character, which will impress itself upon the memory of passers-by by night, with super-flood lighting and colour effects, as well as by day.

The depth of the main building is about 60 ft., and there is room at the back for the sales department and meter department stores and workshops and a sub-station.

There are two display windows in the front elevation, darkened by a loggia because, as sellers of light, we want to do it in the dark. These are duplex windows which can be divided and dressed to show inwards as well as outwards.

Entering the door in the centre, you come into a very fine vestibule hall with two showrooms leading off to right and left. These will be decorated and illuminated in a lavish manner in order to create a good first impression.

On the left are the pay counter and collectors' offices, and on the right the offices of the sales department staff and small sales counter.

Straight through from the entrance door down a few steps you enter a beautiful demonstration hall, surrounded by show windows and with a platform at the end for lantern lectures, kinema displays, &c., which will be used for afternoon teas and for frequent special events calculated to keep alive the interest of the inhabitants in the head-quarters of their electricity undertaking. How few people realise the nature of the industries of their locality! The show windows in the demonstration hall can be used frequently as a local industries fair, and their illumination will constantly be the latest achievement of science in shop-window lighting.

Surrounding the outside of the hall are a series of fitted rooms equipped to illustrate the many uses of electricity, the articles in use being supplemented by alternatives in the showcases facing each room.

It will be noted that the sales department side communicates with the stores and workshop direct.

The upper floors are reached by a public staircase and electric lift, a staff staircase, and a special staircase to the caretaker's quarters on the top floor.

The large general office is situated on the first floor, the space being suitably divided by glass screens so that the heads of departments may supervise the whole of the staff.

On this floor also there are offices for the chief and deputy engineers, the chief clerk, telephone exchange, typists' rooms, committee and consulting rooms, &c.

Documents, papers, &c., will be transported to and

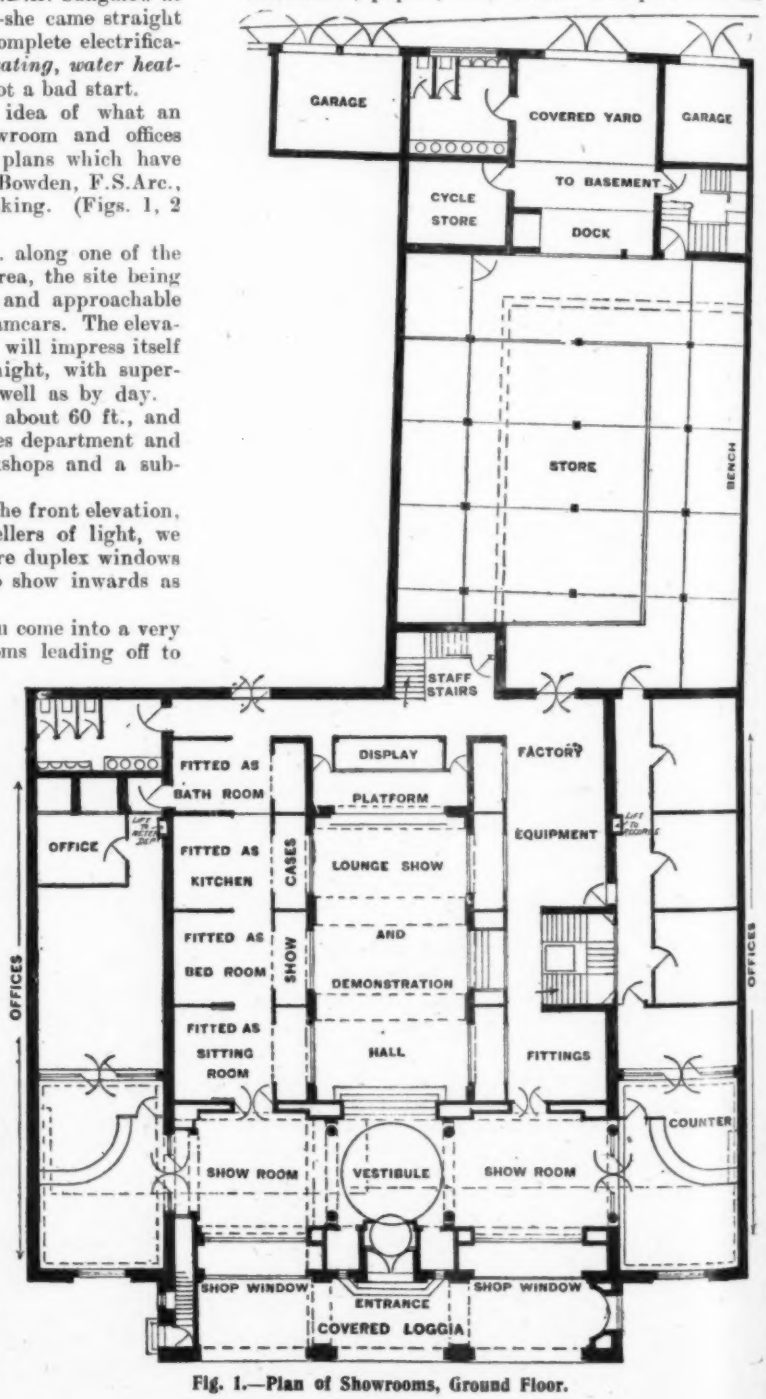


Fig. 1.—Plan of Showrooms, Ground Floor.

from other departments by means of special lifts to save the time generally wasted by messages, &c. The meter department is also situated on this level at the back.

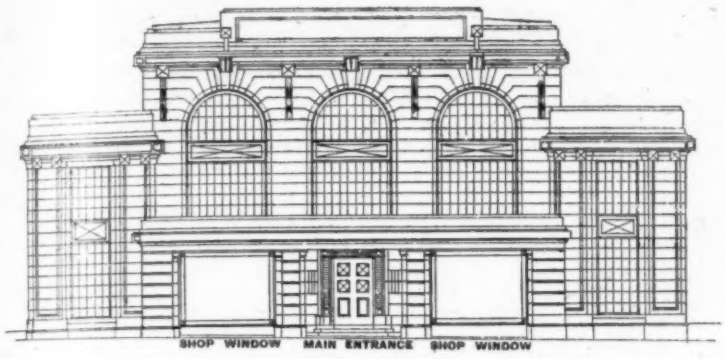


Fig. 2.—Elevation of Showrooms.

On the second floor there are offices for the constructional engineer, and a drawing office with north light, mains and meter department offices, and last, but not least, a working electric kitchen and staff dining-room, where consumers also can be offered samples of electrically-cooked meals.

The top floor is reserved for the caretaker's quarters, and is designed so that, when necessary, another storey can be put on the building.

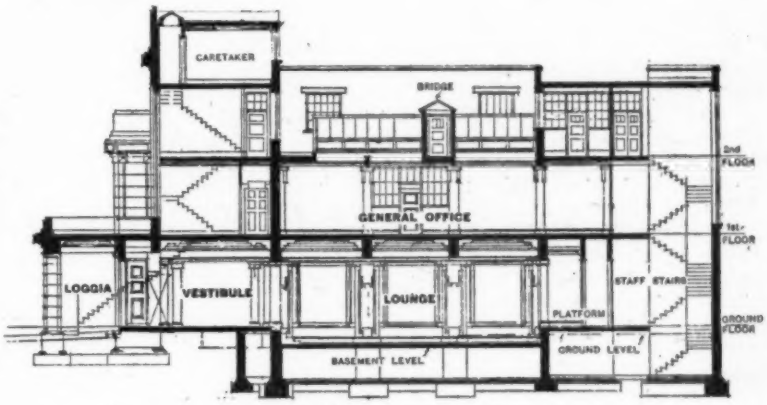


Fig. 3.—Vertical Section of Showrooms.

Working Records for Large Generating Sets.

By "INTERESTED."

WHAT the future holds in store no one can confidently predict. Present-day practice leans towards super-power stations with large steam turbines for the generation of electricity, but, within a few years, the custom may be to install turbines of different pattern using, as has been mentioned in the columns of the ELECTRICAL REVIEW, mercury vapour or other binary fluid systems. Meantime, we must interest ourselves by watching the experiments that are being made in several directions. Who can say that in ten years' time the present type of steam-driven turbine will be obsolete?

When dealing with the actual running of large generating sets, one discovers that the word "efficiency" assumes serious importance. Maximum efficiency is imperative in order to generate cheaply, and to accomplish this close and careful watch must be maintained when operating and running these large sets. Instruments and data are available for the use of the engineer to inform him exactly what is taking place, for it is at all times essential that the engineer should know the condition of his plant with regard to both mechanical and thermal efficiency. Given the quantity of steam being used, the temperature of water at inlet and outlet, the temperature of the vacuum and condensate water, steam pressure and superheat, and a thorough knowledge of coal combustion, a ready and fairly accurate method is to hand for calculating the thermal efficiency of the plant.

One of the most up-to-date stations in this country clearly demonstrates by the book described herewith, which is in use there, that all-round efficiency means a larger surplus at the end of the financial year.

The pattern on the left-hand side of the book almost explains itself, and I would only add the following few explanations:—

WT/R = K kW per square foot per deg. C.
TV = temperature of vacuum.
TC = temperature of condensate water.

On the right-hand side, set out in three shifts, is more detail. The first part calls for various readings from which the collective efficiency of the turbines is obtained. The word "river" means water taken from the neighbouring river, and the assistance of a heat entropy diagram is availed of for this calculation, which tends to save a fair amount of figuring.

Week ending ——

No.	Turbine.	Remarks.
Units Metered	T. 1.	
Running Hours	T. 2.	
Average Hourly Load	W. T/R.	
Lbs. of Steam per KW.	T.V.	
Average Steam Pressure	Vacuum	
" " Temperature	T.C.	
" Superheat "		
	Turbine Efficiency	

No.	Turbine.	Remarks.
Units Metered	T. 1.	
Running Hours	T. 2.	
Average Hourly Load	W. T/R.	
Lbs. of Steam per KW.	T.V.	
Average Steam Pressure	Vacuum	
" " Temperature	T.C.	
" Superheat "		
	Turbine Efficiency	

No.	Turbine.	Remarks.
Units Metered	T. 1.	
Running Hours	T. 2.	
Average Hourly Load	W. T/R.	
Lbs. of Steam per KW.	T.V.	
Average Steam Pressure	Vacuum	
" " Temperature	T.C.	
" Superheat "		
	Turbine Efficiency	

CALORIFIC VALUE OF COALS USED DURING WEEK.

Thro' ... ... B.T.U.
Pass ... ... B.T.U.
Stock ... ... B.T.U.
... ... B.T.U.

QUANTITY OF COAL USED.

Thro' ... ... Tons
Pass ... ... Tons } Total ..... Tons.
Stock ... ... Tons

Average Calorific Value of Coal Used ..... B.T.U.

Left-hand page of Record Book.

The second part of this pattern refers to the steam-

raising plant, from which particulars are obtained to give the combined boiler-house efficiency. Note may be made of the following:—

kW energy per lb. per kWh = B.th.u./3,412.

Station overall efficiency = 1/lb. of coal to mains × energy value of coal.

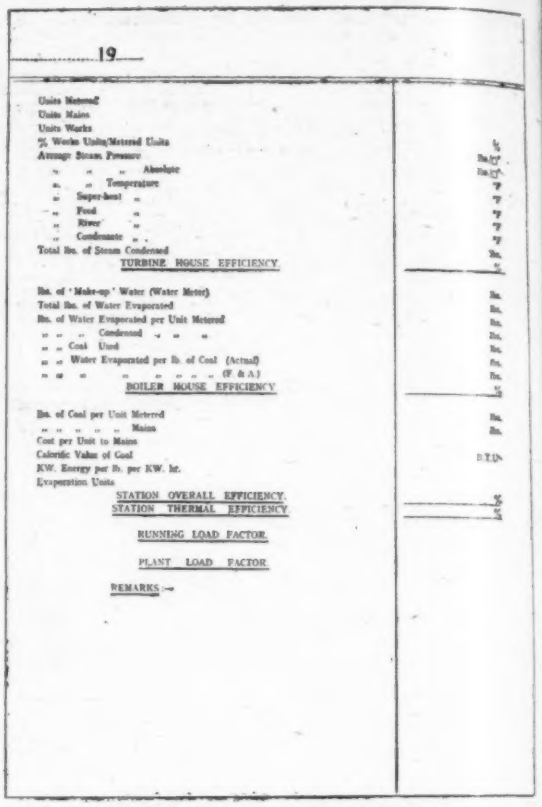
Running load factor = units metered × 100/plant capacity × plant hours running.

Plant load factor = maximum load demanded/plant capacity.

From these brief notes those interested will comprehend the interesting time experienced by the engineer-in-charge on night shift if he is called upon to make all the necessary calculations by the time daylight appears. However, the result is well worth the labour, for thereby valuable detailed records are made available by which the chief is able constantly to feel the pulse of his station, thus making for efficiency and economy.

It is, however, essential that the interest of the men who log the readings and tabulate the data should be stimulated by the results they assist in achieving. If their work ends with the filing of the log-sheets, they will be apt to grudge the considerable time necessary for systematically setting out in final form the maze of operating figures, and this will lead to carelessness and inaccuracy. If they are made to realise, by following the analysis of the operating figures, how much depends on the care and faithfulness with which the figures are collected, much of the present apathy towards such matters will be dispelled.

Local councillors would do well to study this book; then they would realise that an engineer-in-charge has duties reaching farther than "responsible for running the station during an eight-hour shift."



19

Units Metered
Units Mains
Units Works
% Works Units/Metered Units %
Average Steam Pressure lbs/sq"
" " " Absolute lbs/sq"
" " Temperature °F
" Superheat " °F
" Feed " °F
" River " °F
" Condensate " " °F
Total lbs. of Steam Condensed lbs.

TURBINE HOUSE EFFICIENCY %

lbs. of 'Make-up' Water (Water Meter) lbs.
Total lbs. of Water Evaporated lbs.
lbs. of Water Evaporated per Unit Metered lbs.
" " " Condensed " " " lbs.
" " Coal Used lbs.
" " Water Evaporated per lb. of Coal (Actual) lbs.
" " " " " " " (F. & A.) lbs.

BOILER HOUSE EFFICIENCY %

lbs. of Coal per Unit Metered lbs.
" " " " " Mains lbs.
Cost per Unit to Mains
Calorific Value of Coal B.T.U.
KW. Energy per lb. per KW. hr.
Evaporation Units

STATION OVERALL EFFICIENCY %
STATION THERMAL EFFICIENCY %

RUNNING LOAD FACTOR

PLANT LOAD FACTOR

REMARKS:—

Right-hand Page of Record Book.

The Dewpoint Temperature of Gases from Combustion.

By J. N. WAITE, M.I.E.E.

In the literature of combustion one occasionally comes across the statement that the water vapour present in the gases from combustion condenses to liquid water at 212 deg. F. This dictum appears to have been accepted by many engineers as a correct statement of fact; but very little consideration is required to show that it is utterly at variance with the true facts of the case. The gases resulting from combustion obey the ordinary laws of gases, and if the statement referred to were correct, then no aqueous vapour could be present in the ordinary atmosphere, but as is well known the atmosphere always contains water vapour whatever its temperature may be. No further reasoning appears to be necessary to demonstrate that the statement, that water vapour in gases from combustion condenses at 212 deg. F. at atmospheric pressure, is incorrect. Presumably, the acceptance of this statement in the past has been due to the fact that air-free steam at atmospheric pressure does condense at 212 deg. F., and to confusing the meaning of the term water vapour with the term steam. The two terms define two distinct qualities, and are not interchangeable.

In the case of moisture in the air or in the gases from combustion, the moisture is present as water vapour, and forms but a small part by weight of the gas-vapour mixture. The temperature at which the water vapour will begin to be deposited as liquid water is governed by the laws governing humidity of gases, and may be correctly defined as the "dewpoint temperature." When dewpoint temperature is reached the water vapour will start to be deposited as water, and as the temperature of the gas-vapour mixture is reduced further and further below dewpoint, the amount of water deposited increases. To get all the water vapour deposited it would be necessary to reduce the temperature down to the absolute zero.

For the purpose of this article it is only necessary to consider the properties of gas-water mixtures which are fully saturated with water vapour, or have a humidity of 100 per cent. When saturated, the temperature of a gas-water vapour mixture corresponds to the vapour pressure as given by steam tables, but it may be pointed out that although this holds good for saturated gas-vapour mixtures, it does not hold good for mixtures not fully saturated. It can be shown that the actual vapour pressure of a gas-vapour mixture is always approximately equal to the vapour pressure at dewpoint, whatever may be the actual temperature of the mixture.

Dalton's laws lay down that:—

(1) If several gases are enclosed in the same space, each of them exerts the same pressure as if the others were absent, in other words, the pressure exerted by the mixture is equal to the sum of the pressures which each would exert separately.

(2) The mass of vapour which can be contained in a given space is the same whether this space be filled with gas or empty.

(3) When a gas is saturated with vapour, the actual pressure of the mixture is the sum of the pressures due to the gas and vapour separately.

Laws 2 and 3 are not rigorously true, but for all practical purposes they hold good, and therefore it is not necessary, for the purpose in view, to go into

detail regarding the qualifications necessary to make them rigorously true.

Given the respective weights of gas and of water vapour, in a gas-water vapour mixture, it is possible to calculate the dewpoint of such mixture, and also the weight of water vapour deposited as water for any given temperature reduction below dewpoint.

The dewpoint temperature of a gas vapour mixture depends upon the mass of vapour contained in such mixture, and upon consideration it will be seen that dewpoint temperature will be reached when the temperature of the gas-vapour mixture causes the volume of gas present to coincide with the volume of water vapour present.

TABLE I.

Assumed Coal Analysis.		Products of Ideal Combustion.		
	lb.			lb.
Carbon	0·616	CO_2		2·255
Hydrogen ...	0·044	H_2O (from comb'n of H_2)	0·396	0·588
Moisture ...	0·100	H_2O (in Coal)	0·100	
Oxygen	0·060	H_2O (in Air for comb'n)	0·092	
N_2, S, Ash, etc.	0·180	N_2		6·466
	1·000	Total Gas-Vapour... ...		9·309

Dry Air required for Ideal Combustion ... 8·397 lb.
Maximum Theoretical CO_2 by Volume ... 18·17% (CO_2 to N_2).
Nitrogen and Sulphur content neglected.

It is proposed to give in detail a method of calculating dewpoint temperature for the gases resulting for a given fuel, the fuel taken being a medium grade bituminous coal having a medium hydrogen and moisture content. In what follows it is assumed that the atmospheric pressure is 30.0 inches Hg., the air temperature is 60 deg. F., and the air is fully saturated with water vapour or at 100 per cent. humidity. With these conditions, from Glaishier's hygrometrical tables, one lb. of air contains 0.01101 lb. of water vapour.

The gases that result from "ideal" combustion are CO_2 and N_2. In practice, ideal combustion is not achieved and excess air is admitted; this introduces O_2 into the gases from combustion and increases the quantity of N_2. The following Table II gives the quantity of excess air introduced for the given volume percentages of CO_2, the quantity of moisture introduced by this excess air, the total quantity of moisture in the air used, and the total quantity of moisture in the flue gases, for 1 lb. of coal with the analysis given in Table I. It is assumed that combustion is complete.

It has been previously stated that the dewpoint temperature of a gas-vapour mixture will be reached when the temperature of the mixture causes the volume of gas present to equal the volume of the water vapour present. At constant pressure, increase of temperature decreases the density of gas, while with a fully saturated gas-vapour mixture, increase of temperature, assuming the mixture to continue saturated, increases the density of the water vapour, so that if a series of values of gas volume and vapour volume at suitable temperature are calculated and plotted on sectional paper, the intersection of the resulting curves will give the temperature at which their volumes coincide, and this temperature will be the dewpoint temperature.

Table III gives the specific volume of water vapour, and the pressure corresponding to temperature of water vapour over a suitable range of temperature. The values quoted are taken from "Marks & Davis Steam Tables."

TABLE IV. VOLUME OF WATER VAPOUR PRESENT IN FLUE GASES FROM COMBUSTION OF ONE LB. OF COAL HAVING ANALYSIS AS TABLE I.

Temperature of Water Vapour at Saturation Point in °F.	Percentage of CO_2 by Volume.							
	18·17	16·0	14·0	12·0	10·0	8·0	6·0	4·0
	Volume of Water Vapour in Cubic Feet.							
80							491	577
85							421	495
90						330	362	425
95					268	284	312	367
100				222	232	246		
105			187	193	202	214		
110	156	159	163	168	176			
115	136	139	143	147				
120	119	122	125					
125	105	107						

Table IV gives the corresponding volume of the weight of moisture present in the flue gases at various temperatures. It is derived by multiplying the weights of moisture as given by Table II, by the appropriate specific volume given in Table III.

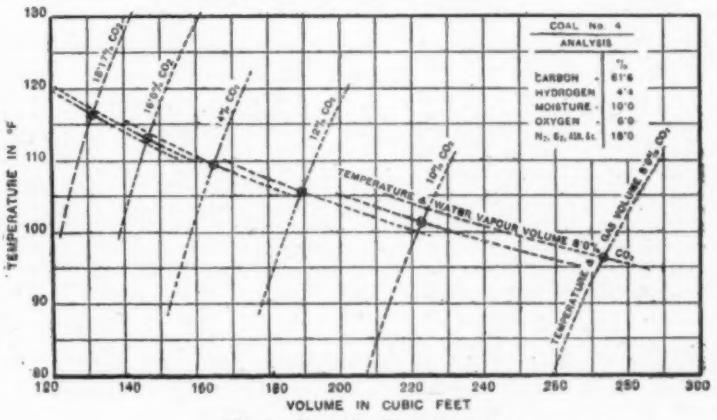


Fig. 1.—Dewpoint Temperatures.

TABLE II. MOISTURE IN EXCESS AIR AND TOTAL MOISTURE IN FLUE GASES (ABOVE DEWPOINT) FROM ONE LB. OF COAL HAVING ANALYSIS AS TABLE I.

CO_2 PERCENTAGE BY VOLUME.. .. .. %	18·17	16·0	14·0	12·0	10·0	8·0	6·0	4·0
Excess Air per lb. of Coal ... ... lb.	0	1·10	2·41	4·18	6·64	10·34	16·49	28·80
Moisture in Excess Air ... ... lb.	0	0·012	0·027	0·046	0·073	0·114	0·182	0·318
Moisture in Air for Combustion ... lb.	0·092	0·104	0·119	0·138	0·165	0·206	0·274	0.410
Moisture in Coal and from Combustion of H_2 lb.	0·496	0·496	0·496	0·496	0·496	0·496	0·496	0·496
Total Moisture in Flue Gases ... ... lbs.	0·588	0·600	0·615	0·634	0·661	0·702	0·770	0·906

TABLE III. SPECIFIC VOLUME AND PRESSURE OF WATER VAPOUR.

TEMPERATURE .. °F	75	80	85	90	95	100	105	110	115	120	125
Pressure ... lb./sq. in.	0·43	0·50	0·59	0·70	0·81	0·95	1·10	1·27	1·47	1·69	1.94
Specific Volume ... cu. ft./lb.	743·0	636·8	545·9	469·3	405·0	350·8	304·7	265·5	231·9	203·1	178·4

TABLE V. SPECIFIC VOLUME OF CO_2 AT 14·73 LB./SQ. IN. ABS: AND AT VARIOUS TEMPERATURES, AND TOTAL GAS PRESSURE OF A SATURATED GAS-VAPOUR MIXTURE.

TEMPERATURE.. .. .. °F	70	80	90	100	110	120	130
Specific Volume of CO_2 ... ... cu. ft./lb.	8·703	8·867	9·030	9·194	9·358	9·521	9·685
Total Gas Pressure ... ... lb./sq. in.	14·37	14·23	14·03	13·78	13·46	13·04	12·51

The gaseous products of combustion are a mixture of gases. From Dalton's law of gas mixtures if the volume of any one of the gases is found, it will correspond to the volume of the mixture. Of the gases from combustion, the volume of the CO_2 content (relative to N_2 and O_2, &c.) is usually measured. The partial pressure exerted by the CO_2 relative to the total gas pressure will be proportional to its relative volume. The total gas pressure is the total pressure of the gas-vapour mixture, minus the vapour pressure. If the weight, percentage volume, and specific volume of the CO_2 content are known then the volume of the gases from combustion can be readily calculated.

Let P_1 = Total pressure of gas-vapour mixture.
P_2 = Vapour pressure.
P_3 = Total gas pressure ($P_1 - P_2$).
V_1 = Specific volume of CO_2 at P_1 pressure.
V_2 = Relative volume of CO_2.
W = Weight of CO_2 from 1 lb. of coal.

Then $W \times V_1 \times P_1/V_2 \times P_3$ = Volume of gases from combustion of 1 lb. of coal.

Table V gives the specific volume of CO_2 at various temperatures at a pressure of 30.0 in. Hg., and also the total pressure of the gas in a saturated gas-vapour mixture at the various temperatures.

Table VI shows the volume of gas from combustion of 1 lb. of coal having analysis as shown in Table I. It has been derived as indicated in the foregoing, using the values shown in Table V.

If the calculated values given in Tables IV and VI are plotted on sectional paper, the intersection of the resulting curves gives the dewpoint temperature of the gases from combustion of coal having the analysis given in Table I, for the various given percentages of CO_2. Examples of these curves, the intersections of which give the dewpoint temperature, are shown in fig. 1. The resultant values are given in Table VII.

TABLE VI. VOLUME OF GAS FROM ONE LB. OF COAL HAVING ANALYSIS AS TABLE I.

Temperature of Gas Vapour Mixture (Saturated) °F.	Percentage of CO_2 by Volume.							
	18·17	16·0	14·0	12·0	10·0	8·0	6·0	4·0
	Volume of Gas in Cubic Feet.							
70								503
80						259	345	503
90				178	213	267	356	554
100	122	139	158	185	222	277	369	577
110	127	144	165	192	231	289	385	
120	134	152	173	202	242			
130	142	161	184					

TABLE VII. DEWPOINT TEMPERATURE OF FLUE GASES FROM COMBUSTION OF COAL HAVING ANALYSIS AS TABLE I.

CO_2 by volume %	18·17	16·0	14·0	12·0	10·0	8·0	6·0	4·0
Dewpoint Temp. °F	116·4	113·0	109·6	105·7	101·4	96·4	90·3	83·3

(To be concluded.)

The Loughborough Electricity Works.

Extension of Generating Plant.

THE Borough of Loughborough first commenced to supply electricity in November, 1904, Brush-Parsons d.c. 450-volt turbo-generators being installed at the outset. Following various extensions, including a change to 3-phase, 50-cycle, 6,600-volt, a.c. generation in 1914, Mr. C. H. Wordingham, C.B.E., was asked to report upon the undertaking early in 1922. In that year the energy generated amounted to 3,781,063 kWh, the maximum demand being 1,805 kW, the number of consumers 838, and the cost of production 1.31d. per kWh.

The extensions, which were made under the supervision of Mr. R. B. Leach, borough electrical engineer and manager, the new plant being officially inaugurated on June 5th, include a 3,000-kW Brush-Ljungström 3,000-r.p.m. turbo-generator, fig. 1, working at a steam pressure of 200 lb. per sq. in., a temperature of 600/650 deg. F., and a vacuum of 28.75 in. The two alternators are 6,600 V, 3-phase, 50-cycle machines, with a lagging p.f. of 0.8, and the set has an overload capacity of 25 per cent. for two hours, being fitted with overload valves which enable it to develop a maximum load of 3,300 kW with a reduced steam pressure of 180 lb. at 580 deg. F. and a vacuum of 28 in. The governor can be hand operated and also electrically controlled from the switchboard, while the lubricating oil is delivered by a rotary pump of the valveless type, in addition to which a separate steam-driven pump has been provided to assist when starting, the oil being continually filtered by means of a "Fox" self-cleaning rapid oil-filter and pumped into the main tank by a separate motor-driven pump.

The condenser is of the two-flow Brush surface type, having a cooling surface of 5,200 sq. ft., capable of dealing with 36,000 lb. of steam per hour, with circulating water at 60 deg. F. Air extraction is effected by a Brush-Delas ejector plant of the two-stage type, the nozzles being in series. The water is extracted from the condenser by a Mirrlees-Watson centrifugal pump, capable of dealing with 60,000 lb. of water per hour when driven at 1,440 r.p.m. by a 4½-b.h.p., 450-volt, d.c. Brush motor. As a stand-by to the Brush-Delas ejector, a Mirrlees-Watson rotary air pump is provided. It has a capacity of 21 lb. of air per hour when driven by a 25-b.h.p. Brush d.c. 450-volt motor at 1,440 r.p.m.

A motor-driven Mather & Platt centrifugal pump provides the circulating water for the condenser. This pump is of the split-casing, low-lift type, and is driven at from 850/1,100 r.p.m. by a Brush d.c. motor of from 60 to 125 b.h.p. controlled by a B.T.-H. totally-enclosed hand-operated pillar in duplicate. The cooling air for the alternators is supplied by a 30-in. "Sirocco" fan capable of delivering 8,000 cu. ft. of air per minute to each alternator against a 6-in. water gauge when driven at from 1,000/1,150 r.p.m. by a Brush d.c., 40-b.h.p., 450-volt motor. The air is drawn through a "Visco" oil-type filter, capable of dealing with 16,000 cu. ft. of air per minute, and an alarm device gives visible and audible signals in the event of a failure of the air supply.

The control gear for the auxiliary motors consists of B.T.-H. hand-operated pillar starters with dust and weatherproof cases, and the measuring apparatus installed includes a B.T.-H. steam flow meter, electrical

thermometers connected to indicators and recorders on the switchboard, a "Scanes" vacuum, and a "Lea" water-indicating, integrating, and recording machine. The pipework for the circulating water was connected to the existing system without interrupting the supply, and to facilitate quick erection the turbo-alternator plant was erected at the same time as the building; no overhead travelling crane was, therefore, available and each portion of the plant was lifted into position by means of a derrick and hand-operated winches. A 1,000-kW, shunt-wound, self-synchronising rotary converter operating in conjunction with a 1,100-kVA, 3-phase, 50-period Brush transformer was supplied by the British Thomson-Houston Co., Ltd., to feed the 440-volt, d.c., three-wire network, so that current is available for use at either 440 or 220 volts.

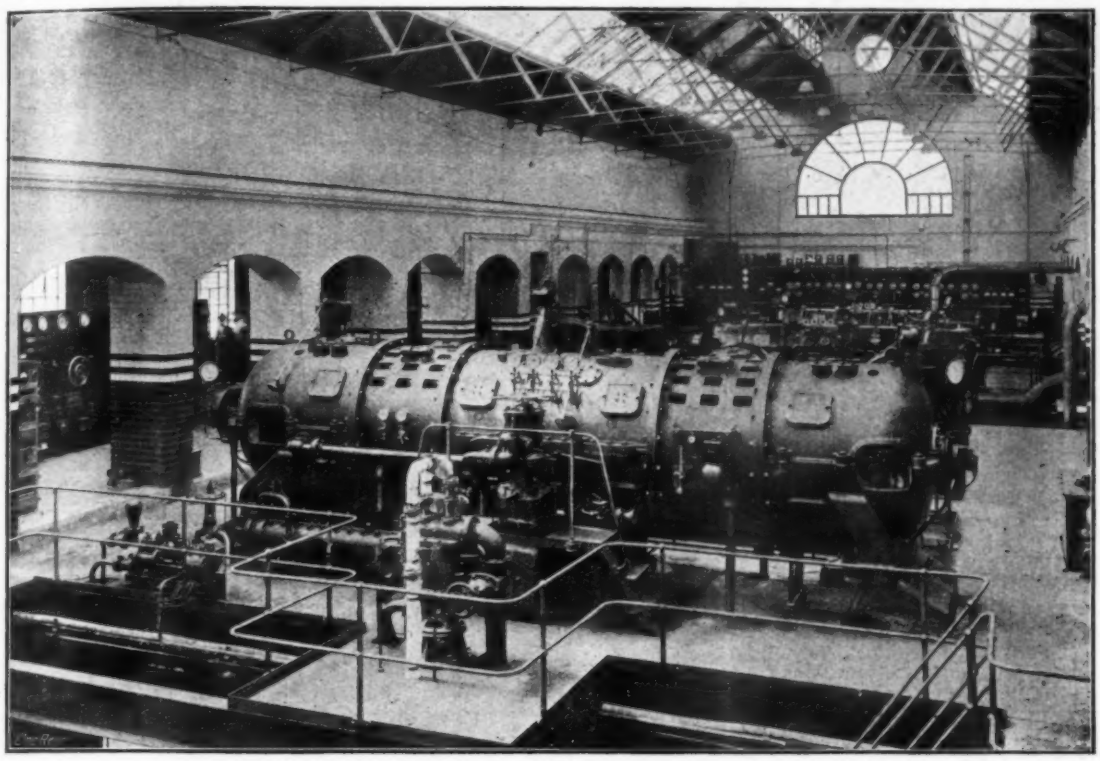


Fig. 1.—New 3,000-kW Brush-Ljungstrom Turbo-Alternator, and Bertram Thomas D.C. Switchboard in Background.

The new boiler is of the cross-drum type, manufactured by the Vickers-Spearing Boiler Co., Ltd. Three drums are provided, a main steam and water drum of 4 ft. diameter, a circulating drum 3 ft. in diameter, and a mud drum also of 3 ft. diameter. The heating surface is 5,320 sq. ft., and the working pressure 225 lb. per sq. in. The superheater, which has a heating surface of 800 sq. ft., is of the Ferguson sectional type.

The economiser is of Messrs. Green's "ring-stay" type, with 200 pipes and a "National" circulator. The firing equipment comprises an 8-retort Erith-Roe mechanical stoker of the underfeed type. The boiler is guaranteed to evaporate continuously at the rate of not less than 25,000 lb. of water per hour, with feed water entering the economiser at 100 deg. F. The superheater gives a final steam temperature of not less than 650 deg. F., and the guaranteed overall efficiency of the boiler, superheater, and economiser, under normal duty is 80 per cent. Among the accessories may be mentioned the turbine boiler-feed pump of Messrs. W. H. Allen, Son and Co.'s make; the Worthington-Simpson feed-water heater; Boby water-softening plant; and the range of instruments mounted on panels within the boiler-house.

New panels for the d.c. switchboard have been supplied by Messrs. Bertram Thomas, while the e.h.p. switchgear has been supplied by Messrs. A. Reyrolle and Co., Ltd., and is of their standard metal-clad type, "B.I." class 6,600-volt, 800-amp. capacity, remote mechanically controlled through slate panels. New e.h.p. feeder cables, pilot cables, and l.p. feeder cables have been supplied, laid, and jointed by the Macintosh Cable Co., Ltd. The contract included two feeder pillars, and new d.c. feeder and distribution cables have been supplied, laid, and jointed by the Union Cable Co., Ltd., laid chiefly in new residential districts.

In conclusion, it may be recorded that the output of the undertaking for the year ended March, 1924, was 4,544,870 kWh, the maximum demand being 2,278 kW, the number of consumers 1,021, and the working cost 0.941d. per kWh.

Science and Labour.—The Conference on Science and Labour which was organised by the British Science Guild was held at the British Empire Exhibition on May 30th and 31st. Mr. Ramsay MacDonald, who was prevented from attending to open the conference, wrote expressing the hope that as a result of it a beginning would be made in the scientific consideration of the problems which confronted Parliament. Mr. Sidney Webb, opening a discussion on the place of science in government, suggested that men of science were apt to develop narrow views which diminished their value in dealing with State problems, and that distinguished men of science who had been elected to Parliament had not achieved distinction in that field. He advocated the encouragement of research, and claimed that the Labour Party in particular upheld the advancement of science. Sir Richard Glazebrook declared that men of science in Government service should have a free hand and adequate power to apply their knowledge to practical ends. Prof. Bairstow pointed out that directors of research in Government departments were subordinate to administrative officials, and urged that the scientific staff should be grouped under a responsible head with direct access to the Minister in charge of a department.

In the discussion on scientific research Mr. Hugo Hirst said the Research Laboratories of the General Electric Co. at Wembley had cost £200,000, and involved an annual outlay of £50,000. He held the view that scientific research must be conducted on broad lines to be successful, and could not be properly carried on by the Government. Sir Oliver Lodge demonstrated the importance to industry of pure scientific research, and suggested that in less than 50 years atomic energy would be made available for practical uses. Major A. G. Church, M.P., doubted whether the "million fund" allotted by the Government to the promotion of research had effected much towards enlightening manufacturers with regard to the industrial value of research, but other speakers supported the Government policy and urged that the experimental period of five years should be extended.

Lord Ashfield spoke on the co-operation of science and labour in production, and other subjects that were discussed included applied psychology and the reform of educational methods.

The "Morganite" Resistor.

A FORM of electrical resistor possessing many distinctive characteristics has recently been produced by the Morgan Crucible Co., Ltd., and the makers have adapted it to a number of uses. In this material, which has been called "Morganite," the company has combined two of its principal products—a refractory material and a graphitic element. By a patent process the latter is incorporated, together with terminal attachments, permanently in a porcelain matrix. In appearance and strength the "Morganite" resistor resembles glazed earthenware or porcelain, and it is immune from damage by water, vapour, acid, or dust. By a patent connection flexible leads can be embedded in the material. The specific resistance of the material can be anything between 0.01 and 1 ohm per cb. in., and, of course, the overall resistance can be varied further, according to the length and cross-sectional area. Under a constant loading of from 5 to 20 W per sq. in., according to the method of mounting and use, the resistor will remain stable and indestructible; on this account it is suitable for domestic heating purposes. For intermittent loading of short duration (¼ min.) the resistor will carry up to 140 W per sq. in. without change, and is thus applicable to high-pressure earthing or current-limiting resistances. Under a constant loading of more than 20 W per sq. in., the effect of the negative temperature coefficient becomes apparent. This resistance change, however, tends to become steady when the heat transfer is equal to the heat generated in the resistor. For this reason the resistance change can be compensated by voltage regulation, and "Morganite" resistors can serve for high-temperature generation up to 1,350 deg. C. The effect of heat on the resistor may be stated as follows:— From atmospheric temperatures to 300 deg. C. (or 572 deg. F.) the effect is negligible, the electrical properties of the resistor being unaffected. Under these conditions its useful life is unlimited. At temperatures in excess of 300 deg. C. the resistor is subject to both temporary and permanent changes in resistance. The temporary change is due to the negative temperature coefficient as explained above, while the permanent change is due to prolonged exposure to heat under oxidising conditions. For domestic heating and cooking, and for industrial processes such as stoving, temperatures in excess of 600 deg. F. are not required, but when the resistor is used in electric furnaces involving temperatures up to 1,350 deg. C. a means of voltage regulation must be provided; this, however, is common to all types of electric furnaces where control of the temperature and rate of heating is required. For motor starters, earthing resistances, and other devices designed for short and intermittent periods of loading, the effect of heating is without influence upon the life of the resistor. Where the loading is continuous or prolonged, as in some control resistances, the resistors can be so grouped and proportioned that the rate of cooling is sufficient to keep the temperature below 300 deg. C.

The specific heat of the material is about 0.25, or more than double that of metallic resistance elements. Thus it is suitable for apparatus for short-period loading, which are designed on the basis of thermal capacity rather than heat dissipation.

Turning to the applications of the "Morganite" resistor, it will be seen at once that it forms an admirable medium for heating purposes. A radiator can be made in panel form on simple mounting, forming a contrast with the more complicated apparatus involved in the use of wire elements. The same loading allows of a wider distributing surface, and there is no chance of the elements burning out or being broken in ordinary use. In addition to this, the same panel, by being turned over to the horizontal position, can be used as a hot plate. Special forms of hot-plates or boiling rings are also made. "Morganite" heaters freely exposed to air may be loaded up to 10 W per sq. in. When the heat transfer is more rapid, as in the case of boiling rings, the loading may be increased to 20 W per sq. in. Conversely, when the heat transfer is obstructed, as in ovens, the maximum safe loading is reduced to 5 W per sq. in. "Morganite" heaters for moderate temperatures lack the psychological attraction of a glowing element, but possess the compensating advantage of equable heat distribution and avoidance of fire risk. The simplicity of the resistor when employed as a heater can be seen from fig. 1, which illustrates a portable radiator panel in a teak frame. Fig. 2 shows a hotplate built on the same principle; the increased "loading space" will be noted.

Fig. 1.—A "Morganite" Radiator.

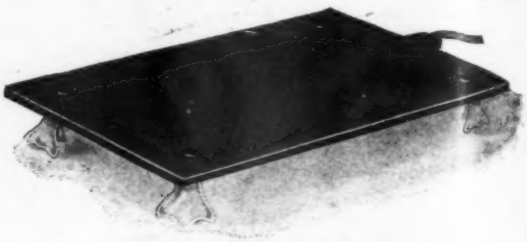


Fig. 2.—A "Morganite" Hot Plate.

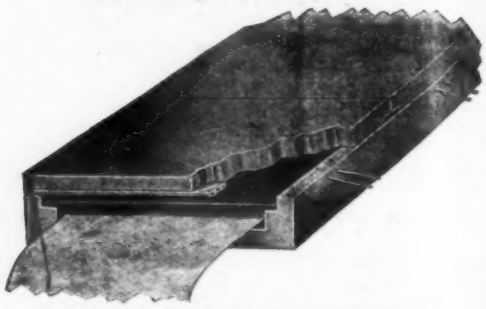


Fig. 3.—An Annealing Furnace for Strip Metal.

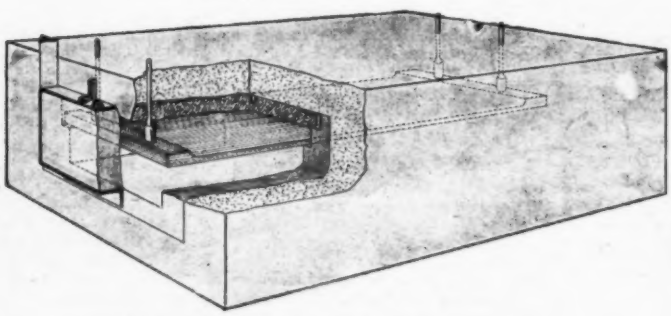


Fig. 4.—A High-temperature Furnace.

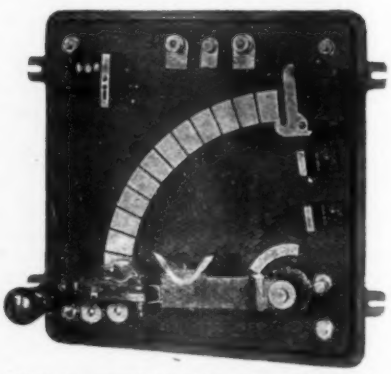


Fig. 5.—Front of 25-h.p. Motor Starter.

"Morganite" has numerous applications in the laboratory, principally on account of its immunity from ill-effects in the presence of acid fumes and other corrosive agents.

In the industrial sphere it also has many uses. A novel form of baking oven can be constructed in which the resistors, besides acting as heaters, also form the shelves. Fig. 3 shows a compact form of annealing or enamel stoving furnace for strip metal. This is built up in sections, enabling the furnace to be of any length. As an impregnating vat

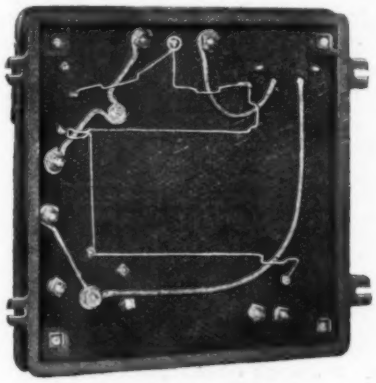


Fig. 6.—Back of 25-h.p. Motor Starter.

heater the resistor is of particular value owing, again, to its immunity from corrosion. The application of the resistor to a high-temperature furnace is illustrated in fig. 4.

As applied to motor starters, the "Morganite" resistor possesses the advantages of excluding any housing for the resistance elements, insulating supports for the elements, and connections between the resistance elements and contact studs; as breakdowns usually occur at these points, the possibility of a fault is materially reduced. The element is arranged in a zig-zag form, and studs are introduced at suitable points. The resistor itself forms the face plate, and to it are fixed all the usual adjuncts. The "Morganite" starter is constructed for the usual range, and complies with the B.E.S.A. specified tests. Figs. 5 and 6 show the front and back of a 25-h.p. starter, respectively.

Fig. 7 shows an earthing resistance in which a number of "Morganite" resistors are mounted on top of one another

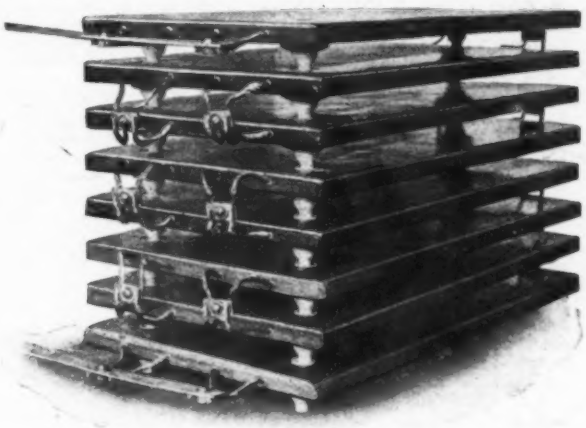


Fig. 7.—A "Morganite" Earthing Resistance.

with intervening porcelain distance pieces. The resistors can also be mounted in a porcelain-insulated frame if required. In this application the negative temperature coefficient is turned to advantage. It enables the ohmic value to be fixed at a figure which will allow only the minimum current to pass for the normal functioning of circuit breakers. Should these fail to operate instantaneously the current will continue to rise until they do.

Other applications of the "Morganite" resistor will no doubt occur to the reader, having in mind his own particular business.

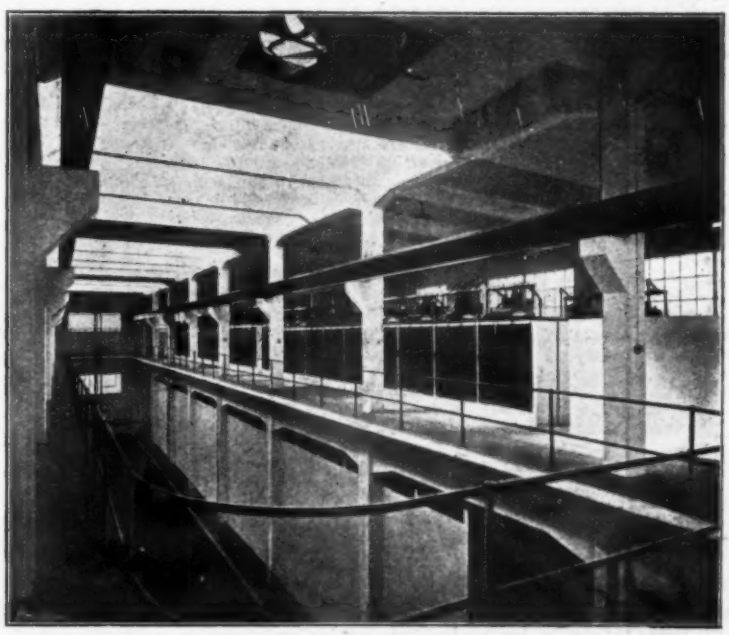
Electricity Supply at Shanghai.

Report upon the Year's Working.

We have received from the chief engineer and manager of the Shanghai Municipal Electricity Department (Mr. T. H. U. Aldridge) a copy of his report covering the year ended December 31st, 1923, together with the accounts.

From the accounts it is seen that the revenue from all sources amounted to 8,572,449 taels (£1,285,866), and the total expenditure to 5,735,489 taels (£860,323), leaving a gross profit of 2,836,960 taels (£425,543). In the previous year the equivalent figures were: Revenue, 7,253,158 taels (£1,087,974); expenditure, 4,970,597 taels (£745,590); and gross profit, 2,282,561 taels (£342,384). After crediting certain small sums and charging interest and other items, there remained a net balance of 1,514,884 taels (£227,233), as compared with 1,221,806 taels (£183,271). To the net profit a balance of 6,731 taels brought forward was added, giving an available balance of 1,521,615 taels (£228,242). This was distributed as follows: To municipal funds, 900,000 taels (£135,000); to general reserve, 602,800 taels (£90,420); carried forward, 18,815 taels (£2,822). Since 1916 the undertaking has contributed 3,760,000 taels (£564,000) to general municipal funds. The total capital outlay upon the undertaking increased during the year from 27,671,552 taels (£4,150,733) to 29,599,162 taels (£4,439,874).

The figures relating to the generation and sale of energy show that the total amount sold was 272,265,861 kWh, an increase of over 17 per cent. upon the 1922 total, in spite of continued trade depression. The sale of energy for power purposes declined by 18,278,115 kWh, but this was more than made up by the increase in consumption by domestic consumers. Satisfaction is expressed with the increase in the heating and cooking load. There was also a net increase of 653 motors, representing 18,324 kW, during the year. The number of motors hired from the department decreased, the reason given being that consumers can now buy motors at lower prices, and find it cheaper to purchase them than to hire them.



6,600-V Switch Gallery at the Fearon Road Sub-station, Shanghai.

E

With the exception of a few minor details, the extensions of the Riverside Station, sanctioned in 1920, were completed. The installed plant capacity is given as 121,000 kW, but it is noted that this includes the 20,000 kW turbo-alternator which was destroyed in November last and is being replaced. The circumstances attending the destruction of this set are detailed in the report; the matter has already been dealt with at some length in our columns. There are 26 boilers in service, including the plant installed under the 1920 extension scheme. The equipment of the new "super-substation" at Fearon Road was almost completed. This substation supersedes the old Fearon Road steam generating station, which is only used now for supplying part of the d.c. traction supply to the Tramway Co. During the present year the station is to be completely shut down and the plant disposed of. Traction supply will then be derived entirely from the Riverside Station, conversion being effected at the new substation. Another "super-substation" at Yangchow Road is nearly completed and ready for use.

The highest simultaneous load on the system during 1923 was 65,632 kW; the load factor fell from 51.5 to 49.42 per cent. This figure still compares favourably with that for British stations of similar size—the nearest being that of Manchester—29.41 per cent. The total connected load at December 31st was 114,949 kW, the additions during the year having amounted to 17,406 kW. The underground cable system was increased by 28.59 miles to a total of 304.40 miles (including 53.19 miles of telephone and pilot cable).

It is estimated that capital expenditure to the extent of 1,859,937 taels (£278,991) will be incurred during the present year.

The size of the new "super-substation" at Fearon Road can be gauged from the accompanying illustration, which is reproduced from the report.

Reviews.

Power Station Efficiency Control. By JOHN BRUCE, A.M.I.E.E., with an Appendix by R. H. PARSONS, M.I.Mech.E. Pp. xiii+244; figs. 75. London: Sir Isaac Pitman & Sons, Ltd., 1924. Price 12s. 6d. net.

Although thermal efficiency is by no means the only criterion of successful design and operation in power station plants, it is intimately associated with production costs and commercial efficiency, and it becomes necessary to devote considerable thought to the various problems involved if the overall costs of production are to be brought down to the economic limit.

The appearance of a book dealing with efficiency matters as a special subject is therefore very opportune, and although the treatise is essentially based on electrical power station practice, the field covered by the author should render the work of practical value to steam power plant engineers generally.

Although the methods of efficiency control outlined in the text are based upon those in use in the generating stations of the Glasgow Corporation, they are generally applicable to other steam power stations, whilst the author's claim that the book should be looked upon in the nature of a talk to power station operating engineers rather than as a technical treatise, certainly errs on the side of modesty.

In introducing his subject the author considers the heat distribution diagram for a modern power station and shows how the calculations of the losses can be expressed so that a heat balance statement may be compiled for the plant.

In an interesting chapter on boilers and boiler room efficiency some practical notes are given on fuels and the analysis and testing of coal, but in regard to coke, commercial varieties seldom give a calorific value of over 14,000 B.th.u. per lb., and it would be safer perhaps to consider the average heating value of ordinary coke as being in the region of 12,000 B.th.u. per lb. as dried.

The notes on coal analysis are useful, but the methods outlined for the determination of moisture are rather unusual and whilst they possibly aim at greater accuracy, the ordinary methods of air-drying for the surface moisture and the usual oven drying at a temperature of from 100 to 110 deg. C. for the inherent moisture give rapid and satisfactory results for ordinary works practice. It is generally inadvisable to use the moisture sample for volatile matter determination, and if a previously oven-dried sample is used then precautions must be taken to ensure that no absorption of inherent moisture takes place during grinding, meshing or weighing, as some coals are remarkably sensitive to moisture absorption. Standard methods of coal testing have been under the consideration of a committee of the Fuel Research Board, which has recently issued a report upon methods of analysis, so that it will be quite possible to work to a definite system and thus enable results to be comparative.

Following a very useful chapter on the combustion of coal, the important subject of boiler room measurements is fully dealt with, the author having had considerable experience in the methods outlined and in the installation and calibration of the apparatus mentioned, so that he has been able to draw upon an unusually varied experience of such matters for the text of this chapter.

One of the most important matters in connection with efficiency control is that of systematically and faithfully recording, tabulating and analysing the operating results of the plant, and it is gratifying to note that the author has gone fully into the whole question, some 26 pages being devoted to such practical considerations as log sheet data and the tabulation of operation results in concise form so that heat balance statements can be compiled.

In the calculation of flue gas weight per lb. of coal consumed the use of simple formulæ is rightly condemned; if accurate results are required it is necessary to consider the chemical and physical properties of the various constituent gases involved. The determination of the heat loss in the gases per lb. of coal consumed may be made in the usual manner indicated in the text, but it would probably be more accurate to take the approximate mean specific heat of the flue gases as 0.25 instead of the figure 0.24 given in the various calculations.

Boiler feed water is briefly considered in an excellent chapter devoted to an account of the impurities usually present and the analysis of feed water samples. Corrosion due to dissolved gases is touched upon, and that useful little apparatus, the Weir corrosion detector, is illustrated and its action explained.

Turbine room efficiency is naturally an important consideration in the modern power station and it is interesting to notice that figures in the region of 26 per cent. are now obtainable, so that the question of efficiency control in the turbine room is becoming of greater importance in operation. Methods of measuring steam pressure, temperature and steam consumption, are dealt with and some useful notes on the estimation of steam flow through turbine nozzles are given from actual tests.

In regard to condensers and auxiliaries, the question of condenser leakage is considered and the author's method of actually weighing the leakage water is undoubtedly more satisfactory than dependence upon either chemical or electrical tests. The necessary measurements on condensing plant are outlined and such points as the determination of the steam used by auxiliaries are considered. A chapter has been devoted to the working out of condenser constants and notes are given on the calculation of operation results.

Electrical measurements are dealt with in the space of some three pages, and whilst admitting that efficiency control is carried out almost wholly on the steam side of the plant, such brief treatment is apt to be a little disappointing to the electrical power station engineer.

Heat balance control methods are naturally interesting to the up-to-date power station engineer, and the author, who has made a special study of the subject, gives some interesting particulars of the various schemes which can be utilised for obtaining effective control. The methods employed in the Dalmarnock power station are explained and a complete heat balance for the plant is given in the text, which although it does not represent the best results so far obtained, suffices to illustrate the method of tabulating the necessary data. The graphical methods of recording the efficiency of each section of the plant are shown and the use of the Parsons line for checking operating results in explained.

A useful Appendix dealing with the analysis of power station records has been contributed by Mr. Robert H. Parsons, and this forms a fitting conclusion to the book.

The author is to be congratulated on having compiled a really useful treatise on the most important aspects of modern power house operation, and the work should certainly be in the hands of all up-to-date engineers interested in the subject. The efficiency control of the large modern power stations in this country is a most important matter demanding the attention of highly trained engineers, and the present volume, though necessarily somewhat brief, may be regarded as an excellent practical contribution to a subject of considerable engineering importance.

The Physical Society of London. Report on Radiation and the Quantum Theory. By J. H. JEANS. Second Edition. Pp. 86. London: Fleetway Press. Price 7s. 6d.

The first edition of this report appeared in 1914, at a time when Bohr's original discovery had but lately been announced; the second edition, now published, comes after ten years of attention concentrated on that discovery; and it is interesting to note the changes Mr. Jeans has introduced, in order to mark the advances that have been made during this decade, notwithstanding the distractions and the difficulties created by the war. One of the advances is marked by a change in the attitude of the author himself. The quantum theory, which may be said to have begun with the present century, was a long time in making itself accepted, and at the date of the first edition of this book Mr. Jeans himself had been but a recent convert to its teaching: Bohr's discovery probably had much weight in fixing his convictions. In the first edition, therefore, is to be detected some of the zeal for which converts have always been noted; that book was, indeed, not only an exposition but a polemic. He himself now speaks of it as an *apologia*, declaring that the quantum theory need no longer be considered to be on the defensive. It certainly marks an advance when an author feels he has no longer to defend, but only to explain.

To the first chapter, which, it will be remembered, deals

with that crucial challenge to Newtonian mechanics: "The total radiant energy per unit of volume in temperature equilibrium with matter, is finite not infinite," is appended a new paragraph, which contains: "Our arguments may not prove the breakdown of the classical mechanics, but merely the non-existence of the ether." Now the theory of relativity requires that it shall be impossible to decide whether or not the ether exists, by means of any physical observation whatever; so that in order to make good the crucial challenge referred to it is necessary to show that the equations of radiation and absorption of energy are the same, whether the energy be radiated into, or absorbed from an ether, or empty space. In the next chapters he proceeds to show that the analysis he gives is independent of the ether altogether, so that its existence does not enter into the question. Chapter IV is much extended by paragraphs dealing with X-ray spectra and the continuous spectrum of hydrogen. Chapter V, which deals with the photo-electric effect, has been largely remodelled in the light of more recent experimentation. Chapter VI, which treats of the specific heat of solids, is not so much altered, and it is a pity, while dealing with the subject of specific heat, that the author has not thought fit to discuss the specific heat of gases as interpreted by the quantum theory. Then is interpolated a chapter, the title of which is new, on the dynamics of the quantum theory; it consists almost entirely of new matter. The values of Planck's constant *h*, as derived from the four types of phenomena—(*i*) black-body radiation; (*ii*) spectra of elements; (*iii*) the photo-electric effect; (*iv*) the specific heat of solids—are set out and compared. The very interesting and ingenious principle of *adiabatic invariants* is introduced and explained. Bohr's much-debated principle of correspondence is stated and discussed in a very clear and concise manner. Also the fine structure of spectral lines is examined by the method of Sommerfeld.

The last chapter is entitled "The physical basis for the quantum theory," as in the former edition. It makes an eighth chapter in this, and one which is also almost entirely new. To the words, "An attempt to imagine a universe in which *action* is atomic, leads the mind into a state of hopeless confusion," he has now added, "But there is no reason for thinking the ultimate physical atomicity is that of *action*," and he ends on an open note: ". . . To some minds it may appear as likely that the ultimate scheme of nature will prove to be discontinuous as that it will be continuous. The circumstance that discontinuity was an unexpected solution of the problem ought not to prejudice us against the possibility of its being the final solution. For the history of science teaches that each great advance towards ultimate reality has shown this reality to lie in an entirely unsuspected direction." So humility is a virtue even in pure science.

Foundry Work. By W. R. NEEDHAM. Pp. vi+146; figs. 92. London: Blackie & Son. Price, 2s. 6d. net.

This little book is intended as a primer for the use of apprentices and boys who intend to become moulders, and will also be of great use to apprentice pattern makers.

The language and method of presentation is simple, and can be understood by the novice; at the same time the student is encouraged to think out for himself the necessary principles and processes.

An elementary outline of the different branches of moulding is given in a practical and readable manner, moulding sands, preparation of metals, cores and core ovens, different classes of moulds, brass and steel moulding, are all considered and treated by one who knows the subject thoroughly and who is capable of imparting knowledge in a lucid and practical manner.

The list of questions and exercises at the end of each chapter is particularly good, the illustrations are very clear, and altogether the book can be said to fulfil its purpose in a most satisfactory manner.

The author is to be commended on producing, within the limits at his disposal, a book so full of really reliable and practical information.

Young electrical and mechanical engineers have, as a rule, a very limited knowledge of the methods of producing metal castings, and can be recommended to read this book with advantage to themselves and profit to their profession.

E. P.

Automatic Telephones. By F. A. ELLSON, B.Sc., A.M.I.E.E. Pp. xii+215. Figs. 48. London: Sir Isaac Pitman and Sons, Ltd. Price, 5s. net.

This small volume is one of the series of technical primers issued by Messrs. Pitman, and is written with the object of providing an introduction to the principles and methods of automatic telephony.

Full explanations are given of the Automatic Telephone Manufacturing Co.'s system; and the systems of the Western Electric Co. and of the Relay Automatic Telephone Co. are sufficiently dealt with to enable the reader to grasp their underlying principles.

Brief descriptions are given of the Panel system of the Western Electric Co. and of the Director system of the Automatic Telephone Manufacturing Co. Circuit diagrams, obtained from Post Office sources, are a useful feature of the work, as also is the glossary of terms used in automatic telephony which is given at the end of the volume.

Within its necessarily narrow limits the book will be found to provide a readable and useful preparatory manual to the larger and more comprehensive works on the subject. It is excellently printed, and the diagrams are clearly reproduced.

Business Notes.

Bankruptcy Proceedings.—H. HUNT, electrical engineer (lately trading with Ernest Hicks as Hicks, Hunt & Co., electrical engineers, 6, Cooper Street, Bury), 1, Garston Street, Bury.—Receiving order made May 30th on debtor's own petition.

J. L. JAMES (W. G. James & Son), electrical engineer, 62, Canterbury Street, Gillingham, and 137, High Street, Rochester.—Trustee, Mr. E. H. Hawkins, 4, Charterhouse Square, E.C., appointed May 29th.

T. G. SLATER (Slater Bros.), electrical engineer, 25, Dickinson Street, Mount Street, Manchester.—Trustee, Mr. J. G. Gibson, Official Receiver, Byrom Street, Manchester, released May 26th.

R. S. MAGSON (R. S. Magson & Co.), electrical engineer, 10, Stoney Stanton Road, Coventry.—Last day for proofs for dividend, June 18th. Trustee, Mr. C. J. Band, 9-11, High Street, Coventry.

H. E. CHECKLEY, plumber and electrician, 20, West Street, Morecambe.—Last day for proofs for dividend, June 14th. Trustee, Mr. J. F. Warburton, 28, Queen Street, Manchester.

H. HAYDON & Co., LTD., 3, Welford Road, Leicester.—The following are creditors herein:—

	£		£
Hart Accumulator Co., Ltd. ...	90	Chloride Electrical Storage Co., Ltd.	101
Marconi's Wireless Telegraph Co., Ltd.	200	H. R. Cleave & Co.	51
Pope's Electric Lamps, Ltd. ...	33	D. P. Battery Co.	52
Standard Catalogue Co.	32	General Electric Co., Ltd. ...	218
Bankers	1,271	Johnson & Phillips, Ltd. ...	206
Barron Pearson Engineering Co., Ltd.	17	Midland Electric Manufacturing Co., Ltd.	16
Bray & Bray	21	W. McGeoch & Co., Ltd. ...	57
S. R. Neal & Co.	22	Petters, Ltd.	65
C. F. Young, Ltd.	214	J. Sikes	18
Cutting Bros., Ltd.	26	Walsall Hardware Co., Ltd. ...	156

I. FAULKNER (PROVINCIAL LIGHTING & ENGINEERING CO.).—Electrical engineer, 369, Eccles New Road, Weaste. Receiving order made June 2nd, on debtor's own petition.

A. V. CLAYTON (CLAYTON MOTORS), engineer, Park Lane Mills, Chorley Lane, Leeds.—First and final dividend of 1½d. in the £, payable June 25th, at the Official Receiver's Office, 24, Bond Street, Leeds.

Company Liquidations.—THE GRAY ELECTRICAL CO., LTD., 40a, Greek Street, Soho, late 110, Charing Cross Road, London, S.W.—A meeting of the creditors of the above was held on June 3rd at the offices of Messrs. Corfield & Cripwell, accountants and auditors, Balfour House, Finsbury Pavement, E.C. Mr. W. A. J. Osborne, the liquidator in the voluntary liquidation of the company, occupied the chair, and submitted a statement of affairs, which showed liabilities of £1,620. The assets were estimated to realise £610, or a deficiency of £1,010.

Mr. Osborne stated that the books had been badly kept during recent months, and it was impossible to prepare accurate trading figures. Some £400 of the deficiency was accounted for by the depreciation written off the assets. A question might arise regarding a business at Streatham Hill. That shop was opened by a Mr. Barrett, and the ownership was in dispute. The minutes of the company referred to the shop, and the company had ordered goods which had gone to Streatham. The premises were taken in June or July of last year, and Mr. Barrett invested £1,000 in shares in the company. A sum of £400 out of the £1,000 went into the business and £600 was spent on stock. Since the formation the company had supplied goods to the Streatham shop to the value of £500 or £600, while on three occasions cash had been remitted from that establishment. As liquidator of the company, he had not taken possession of the assets at Streatham, and Mr. Barrett had intimated that any claim to the goods there would be resisted. Proceeding, Mr. Osborne stated that the company was registered on September 6th, 1923. Prior to that date Mr. Gray had conducted a business at High Street, Soho, which was started about July, 1922. It was at first proposed that the company should be called the Electrical Stores (London), Ltd., but that project never fructified. At the formation Mr. Gray received 3,000 fully-paid £1 shares, while Mr. Barrett subscribed £1,000 in cash for shares. The company traded at 110, Charing Cross Road, for a time. Mr. Gray held those premises at a rental of £9 per week, which amount he charged to the company. The greater portion of the stock was removed from Charing Cross Road to Greek Street a few weeks ago. After the notice had been sent out

calling the shareholders' meeting to pass the resolution for voluntary liquidation, he was surprised to learn that certain stock had been removed to Streatham. He believed, however, that that stock would be returned. He suggested that a committee of the principal creditors should be appointed to act with him, and they could then consider the facts relating to the Streatham business.

In answer to a question, the chairman stated that the lease of the Streatham premises was held by Mr. Barrett. Presumably no details regarding the company, or very few, appeared on the file at Somerset House. Two sons of Mr. Barrett were employed at the Streatham Hill shop at salaries of £4 a week each, while two sons of one of the directors were employed in another establishment at £2 10s. a week each. He understood that since the inception of the company the turnover had been about £8,000. No self-respecting accountant would attempt to prepare detailed figures of the trading. Apparently Mr. Barrett had regarded his £1,000 as a loan to the company, when it was really an investment.

Mr. Gray stated that he resigned from the company early in April, and announced that fact in the ELECTRICAL REVIEW. He resigned because he could not get any money from the company, which also owed him a sum for rent. He agreed that it would have been better if the company had gone into liquidation months ago, but it was understood that further capital would be introduced.

During the discussion which took place, dissatisfaction was expressed at the position disclosed, and a creditor suggested that a petition for the compulsory liquidation of the company should be filed. Mr. Osborne, however, pointed out that he was nominated as liquidator at the instance of the creditors, and if a committee was appointed a full investigation into the affairs of the company would take place. He believed that a satisfactory settlement regarding the Streatham business could be arrived at.

Eventually a resolution was unanimously passed confirming the voluntary liquidation of the company, with Mr. Osborne as liquidator, together with a committee consisting of the representatives of the General Cable Manufacturing Co., Ltd., M. E. L., Ltd., and Mr. E. Judd, of Corfield's Traders' Association.

The following are the principal creditors:—

	£		£
A. C. Cossor, Ltd.	68	J. E. Haugh, Ltd.	50
Clayton Rubber Co.	49	A. & J. James	34
Edison Swan Electric Co., Ltd.	39	M. E. L., Ltd.	71
Enterprise Manufacturing Co., Ltd.	15	Mullard Radio Valves, Ltd. ...	16
Electrical Manufacturing and Supplies Co., Ltd.	17	R. A. Ratherenel, Ltd.	18
Fuller's United Electric Works, Ltd.	51	Sherman & Son	67
Falk, Stadelmann & Co., Ltd. ...	32	Shenton & Co., Ltd.	26
General Radio Co., Ltd.	64	Sun Electrical Co., Ltd. ...	24
General Cable Manufacturing Co., Ltd.	52	J. H. Stewart & Co.	16
		County of London Electric Supply Co., Ltd.	25
		Bankers	215
		A. Gray	271

CAR IGNITION AND LIGHTING CO., LTD.—A meeting of members is called for July 9th at 24, Peterborough Road, Parsons Green, S.W., to hear an account of the winding-up from the liquidator, Mr. J. P. Cave.

SPRINGFIELD ELECTRIC MOTORS, LTD., Guiseley.—Following the meeting of creditors reported in the ELECTRICAL REVIEW for April 25th, p. 653, an application was made for an order that the winding up of the company be continued under the supervision of the Court, and the Court granted the application. The Court has conceded permission to sell the land and buildings, fixtures, and fittings. The assets yet unrealised are the plant and machinery for making motors, a small stock of finished motors, and sundry debtors. The liquidator, Mr. V. Walton, states that there are still several matters to be judicially determined by the Court, among others the interpretation of the vending agreement. Application is being made for these matters to be heard at an early date. The liquidator will issue a further statement shortly; at present he is not in a position to distribute any dividend to the unsecured creditors.

BRITISH RADIO SALES CO., LTD., 8 and 9, Stephen's Buildings, Grosse Street, Rathbone Place, London, W.—Under a winding-up order made against this company on April 29th, on the petition of the British Broadcasting Co., Ltd., the statutory meetings of the creditors and of the shareholders were held on June 4th at the Board of Trade Offices, 33, Carey Street, W.C. Mr. G. Digby Pepys, Official Receiver, said that the company was incorporated on August 15th, 1922, with a nominal capital of £10,000, divided into 200,000 shares of 1s. each, and it was formed for the purpose of carrying on business as manufacturers of and dealers in wireless apparatus and installations. The directors had been Miss Edith M. Russell, who acted as chairman for some time, and Miss Elizabeth G. Beddingfield. They both resigned on April 4th last. Mr. J. J. Bamberger was then appointed a director, while Mr. Lennox Lockner had taken Miss Russell's place as chairman. No directors' fees appeared to have been paid except to Miss Russell, who had received £75. On the company's formation Bamberger was appointed sales manager at £250 per annum, plus a commission of 2½ per cent. on all purchases and also on the profits received by the company on the sale of its products, but he only appeared to have drawn anything up to October, 1922. The promoters were Bamberger and Mr. H. W. Parker, both of whom he believed were citizens of the United States, and the former had stated that in June, 1922, he began with the latter to manufacture and sell wireless sets under the name of the British Radio Sales Co. The business was, however, conducted under the name of a nominee as it was thought that licences to manufacture radio products would only be granted to British subjects. Bamberger and Parker also caused the registration of the Lincoln Trust Co., with Miss Russell as proprietor, and this, from July, 1922, circularised the public with particulars of the wireless apparatus manufactured by their business and asked for subscriptions for shares of the British Radio Sales Co., Ltd., which was then in course of formation. The Lincoln Trust received considerable sums of money, which were used to obtain stock contracts, and a tenancy agreement of 8 and 9, Stephen's Buildings. On September 9th, 1922, the British Radio Sales Co., Ltd., bought the stock, contracts, and other assets of the business of the Radio Sales Co. at cost price, and it agreed to re-imburse the Lincoln Trust for all expenditure up to £3,000. As a matter of fact, no agreement for sale or purchase was filed and none had been produced to the Official Receiver, but the books of the company showed the position as at September 14th, 1922, as follows:—Shares subscribed by the public 37,93 (through the Lincoln Trust), 4,599 by the Lincoln Trust itself and 7,500 issued as fully paid to the Trust under an underwriting agreement concerning commission. Trade creditors for advertising appeared at £715, while the Trust was owed £2,815, for the purchase of stock. On the other side of the account appeared cash £139, fixtures and fittings £126, stock £2,550, preliminary expenses £370, and the Trust in respect of cash subscribed for shares £2,525. Early in October last the company bought certain provisional patents and designs of wireless apparatus from Parker for £5,000, which he used to subscribe for shares in the company, and these in turn with other shares were sold by the Lincoln Trust to the public. In September, 1922, the Trust entered into an agreement to find subscribers for a number of shares in consideration of a commission of £375, payable in fully paid shares of the company; there was also a second underwriting agreement with the Trust for the same amount of commission in respect of shares numbering 34,193. Then the Trust having entered into those agreements, and obtained an option on the company's shares at par, sold the shares to the public through the medium of certain circulars, which it was difficult to believe would have led to the public investing a single penny. Continuing, the chairman said that he believed that the shares to a considerable extent were sold at a premium of 6d. a share or more. In that way 70,500 shares were sold by the Trust to the public, and a very considerable sum was paid over to this company. It seemed that the 100,000 shares allotted to Parker were also sold by the Trust to the public, and it was at present impossible to say what profit was made by the Trust. Bamberger declared that the expenses of circularising the public were very heavy, and that the Trust handed over the amount that it received by way of premium on shares, and also the proceeds of the sale of Parker's shares. If that proved to be the fact, commented the chairman, then the Trust must have expended £5,000 in unloading the shares, otherwise there was a profit of £5,000 which it had made and which was not accounted for. The business of the company seemed to have been unprofitable throughout. On October 31st last the accounts showed that there had been a gross loss on the trading of £1,463, and the trading account showed that the amount for sales and stock was even less than the amount of the purchases, without taking into consideration the expenses of the management. The net loss was £7,127, a sum of £2,290 having been spent on advertising and stationery. Bamberger asserted that the loss on trading was due to foreign competition. Last August the board resolved, in consequence of the restriction of business, that a loan should be obtained on the company's property, secured by a debenture for £500. The money was needed to pay wages, &c., and the debenture was actually issued. A month afterwards the debenture holder, who was thought to be the nominee of some friends of Bamberger's in America, who had advanced the money, appointed him as receiver and manager. Since then, however, the business of the company seemed to have been conducted in precisely the same manner as before. He had apparently expended £2,108, as against receipts amounting to £2,118. The statement of the company's affairs was now in course of preparation. A sum of £70 was said to have been paid in reduction of the amount owing on the debentures, and at the date of the liquidation the receiver estimated that the assets consisted of book debts £300, and stock £280, but the Official Receiver was informed that not more than £125 would be received from the latter item. There could thus be nothing for the claims of the unsecured creditors, which amounted to £2,954. Bamberger, however, himself appeared to be a creditor for £1,100 in respect of commission, salary, &c. Quite a number of the claims of creditors seemed to be in respect of credit given since the appointment of the receiver for the debenture holder, but the receiver said that, on the other hand, he had paid away £1,180 to trade creditors. The meeting resulted in the liquidation remaining in the hands of the Official Receiver.

DUX ELECTRIC QUILT & FIBRIL, LTD.—Winding up voluntarily. Liquidator, Mr. E. W. Johnson, Arcade Chambers, Wigan. Meeting of creditors, June 19th, at the offices of Messrs. Holmes & Turner, Arcade Chambers, Wigan; particulars of claims to the Liquidator by July 19th.

Trade Announcements.—ROTAX (MOTOR ACCESSORIES), LTD., has appointed Messrs. Rock, Thorpe & Watson, 62, Grosvenor Road, Tunbridge Wells, and Messrs. Spauls, Ltd., Castle Hill, Norwich, official service agents for Rotax electrical equipments.

MR. S. BECK, electrical and wireless engineer, of Weston-super-Mare, announces that he has discontinued business.

THE POWER EQUIPMENT CO., LTD., has removed to Kingsbury Works, The Hyde, Hendon, London, N.W.9.

MR. E. MERCER, A.M.I.E.E., of Castleford, Yorks., has removed his wireless depôt from Smallthorne Lane to 37, Bridge Street.

THE RADIO EQUIPMENT CO., LTD., has removed to 5, Dyers' Buildings, Holborn, E.C.1.

THE METROPOLITAN-VICKERS ELECTRICAL CO., LTD., announce that owing to the growth of the Supply section of the business a separate company is being formed to deal with the sale of electrical supply products. It will be known as the Metro-Vick Supplies, Ltd., and will be entirely owned by the above company, whose existing organisation will be extended, and transferred to it. Communications should be sent to the same address (Trafford Park), but as from to-day, 16th inst., the new name should be used, instead of that of the parent company.

Book Notices.—"The South African." We have received the first number of this paper, which is being published weekly for a period of 13 weeks from the South African Newspapers' Bureau at the British Empire Exhibition, Wembley. The paper is intended for South Africans who are visiting England in connection with the British Empire Exhibition, as well as for those who are, or who are likely to be, interested in South Africa. It is supplied free, on payment of the postage. London: Argus South African Newspapers, Ltd.

"Electrolytic Rectifiers." By N. A. de Bruyne. Pp. vii+75. London: Sir Isaac Pitman & Sons, Ltd. Price 3s. 6d. net.

"Faraday House Journal," Vol. X, No. 6.—The summer term issue, besides the usual notes and notices of interest to Faradians, contains an article on the City of Winnipeg hydro-electric system; an account of Mr. F. Contell's self-exciting alternator, described in the ELECTRICAL REVIEW in February last; and an article on the internal-combustion turbine.

"Conduit Wiring," By T. Croft. Pp. xi+458; figs. 700. London: McGraw Hill Publishing Co., Ltd. Price 15s.

"Pulverised Fuel and Efficient Steam Generation," by D. Brownlie, B.Sc., together with discussions at meetings of the I.E.E. Pp. 85. Reprinted from the *Journal* of the Institution of Electrical Engineers, May, 1924.

Catalogues and Lists.—MESSRS. FERGUSON, PAILIN, LTD., Higher Openshaw, Manchester.—Illustrated catalogue additions describing the following: Type PA oil circuit breaker; type Q indoor oil breaker; and rotary pattern isolating switches.

IMPAG, LTD., 88, Fenchurch Street, London, E.C.3.—80-page illustrated catalogue of insulating materials made by Micafil, Ltd., whose works are at Zurich-Altstetten, Switzerland.

THE BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, London, W.C.2.—Four-page circular containing approximately 200 small illustrations of many types of Mazda lamps, fittings, plant and equipment, &c.

AUTOMATIC & ELECTRIC FURNACES, LTD., 173-175, Farringdon Road, London, E.C.1.—List H.S.2, describing and giving prices of a high-speed steel hardening surface.

MR. W. H. PETTIFOR, 11, Victoria Street, London, S.W.1.—Price list of electrical and mechanical aids for the deaf.

STERLING TELEPHONE & ELECTRIC CO., LTD., 210-212, Tottenham Court Road, London, W.1.—Forty-page catalogue illustrating and describing the company's standard central battery type of telephone switchboards, and components and accessories.

New Industrial Estate.—From the NOTTINGHAM COLWICK ESTATES, LTD., of Colwick, near Nottingham, we have received a brochure setting forth the special features which make Colwick a desirable centre in which to establish new manufacturing industries. It contains maps and a number of attractive illustrations.

Congress of Municipalities at Amsterdam.—The Second International Congress of Towns, organised by the International Union of Towns, is to take place at Amsterdam on June 30th and July 1st and 2nd, under the official support of the municipality of Amsterdam. The first such congress was held at Ghent in 1913. The subjects coming forward this year include the organisation of permanent relations between municipalities, the development of mutual documentation, and international co-operation in matters relating to hygiene, &c.

International Exhibition in New Zealand.—An International Exhibition is to be held in Dunedin, New Zealand, opening about November 12th, 1925. The New Zealand Government has given its patronage to the project, and is also assisting it financially. This will be the fourth International Exhibition held in New Zealand. The last, held in Christchurch in 1906-7, was a great success, and it is hoped that next year's event will surpass all previous records.—*Reuter's Trade Service* (Melbourne).

New Showroom.—The Chester Electricity Committee has received the sanction of the Electricity Commissioners to the borrowing of £10,000 for the purchase of property to provide showrooms and offices for the electricity undertaking.

Manufacturing in Belgium.—The Société d'Electricité et de Mécanique (Thomson-Houston and Carels) reports that the industrial situation of the undertaking improved during 1923, although its development was temporarily stopped through the economic crisis of 1921 and the strike in 1922. The orders booked both in the electrical and mechanical departments in 1923 showed an appreciable increase over the previous year, and the number of workmen at the end of 1923 was greatly in excess of that of any previous year. The profit on manufacturing undertakings, and sales amounted to 2,895,000 fr., whereas in 1922 there was a loss of 826,000 fr. Unfortunately, the profits were insufficient to meet the financial and depreciation charges. The increase in the financial charges was due to the dearness of money, the depreciation of the national currency, and overdrafts on the bank. It was proposed to lay before the shareholders proposals for a reorganisation. The development of the company's manufactures will render the undertaking in the future less sensitive to variations in foreign exchange. To-day the Ghent works are able to construct all the machinery that it is of economic interest to produce in Belgium. On the other hand, the company, while endeavouring to reduce its general expenses, has developed the activity of its selling department by increasing the number of its commercial representatives. During the year the first semi-Diesel engines were delivered to customers, and had given full satisfaction to the industries using them. Special attention is being devoted to the production of "Mazda" lamps in Belgium, and the company anticipates being able to secure a large part of the Belgian market in the course of a few months. In the department of telegraphy and telephony an agreement based upon patents was signed with the most important wireless telegraph company in Belgium. Including the loss brought from 1922, the accounts for 1923 closed with a total loss of 3,220,000 fr. The annual meeting was held recently. The particulars of the financial reorganisation scheme will be submitted to a future meeting.

Electrical Contractors in London.—In the "Reports" Section of the *Electrical Contractor* for June there is a summary of the statement made by Mr. H. T. Young, the chairman, at the annual general meeting of the London Branch of the Electrical Contractors' Association, held at Savoy Street on May 7th. Mr. Young reported that during the year under review the Development Committee had continued its policy of bringing the Association and the advantages to be gained by joining it to the attention of firms and persons engaged in the contracting business, who were not members. "Mr. Penwell has visited districts as far apart as Wimbledon and Southend, and called on a large number of contractors. Approximately 900 letters have also been sent out from these offices. The conclusions we have now arrived at are these. There are not more than 10 firms outside this Association in the Metropolitan area we would place in a category as 'highly desirable.' These firms have not joined for reasons of their own which are unknown to us. There are about 100 firms one would style as eligible, most of whom remain outside the Association because they say they do not see their way clear to meet the subscription. There are more than 800 persons engaged in contracting, most of whom are really ineligible for any of the three Associations. These are principally men who work from their own homes, some employ one or two men or boys, some work entirely on their own, and some work for themselves to-day and for us to-morrow. Amongst this number there are several ironmonger and builder firms who do a certain amount of installation work as a side line. The number given is on the low side. It has been compiled from investigations of the Committee and unofficial information obtained through various sources, including supply authorities. Most of these people do very poor work indeed, employ cheap labour, and use cheap materials, and are no good to the electrical industry. They do the genuine contractor a great deal of harm by injuring his prestige and by cutting his throat financially. They rarely have establishment charges to meet. These people are actually taking away business to the value of more than £400,000 every year. This is a very conservative estimate, the amount is certainly higher. They take all they can out of the industry and put very little but bad work into it. Something more must be done to combat this. Registration will help, but we must endeavour to get to the source from which they obtain materials. Contractors should refrain from selling wiring materials (except possibly at full retail prices), and a sharper eye should be kept on manufacturers, wholesalers and factors. Also the facts should be put before the Trades Union, who, like ourselves, must be aware of this competition, but may not have gone deeply into the subject."

British Empire Exhibition Notes.—For the evening performances of the Rodeo, what is said to be the largest electric lighting installation in the world is being put into the Stadium. There will be 40 projectors, each containing two 1,000-W lights.

It is officially announced that the attendance at Wembley on Bank Holiday, June 9th, broke all records, the number of visitors being 321,232.

For Sale.—By order of the liquidator of G. H. Turner and Co., Ltd., silk shade manufacturers, 9, Cross Street, Hatton Garden, Messrs. H. Butcher & Co., 63 & 64, Chancery Lane, invite offers for the stock in trade, consisting of silk shades, wire frames, electric lamps, fittings, furniture, &c. (See our advertisement pages to-day.)

New Belgian Companies.—There has been formed at Antwerp (19, Rue Neuve) The Continental Radio and Electric Co., for the manufacture, purchase, and sale of electrical and mechanical apparatus. Capital, 250,000 fr.

The Société d'Electricité d'Eupen et Extensions is the style of a company formed at Eupen, with a capital of 5,000,000 fr., for the building and working of central stations and networks for the supply of electricity for all purposes.

Unemployment.—The number of persons on May 26th recorded on the registers of Employment Exchanges in Great Britain was 1,015,600. This was 5,432 less than on May 19th, 1924, and 270,023 less than on December 31st, 1923.

Lighting and Power Notes.

Argentina.—The report of the Compania Hispano-Americana de Electricidad for last year shows that the company is now supplying electricity to 165,000 consumers in the Buenos Aires district, representing a consumption of approximately 186,000 kW. The output of the generating stations during last year amounted to 385,000,000 kWh, an increase of 42,000,000 kWh over 1922. During 1923 a new turbo-generator of 25,000 kW capacity was installed; a second one of the same capacity was completed in January last and a third in March.

Australia.—NEWCASTLE (N.S.W.).—The accounts of the city electricity undertaking (electrical engineer and manager: Mr. G. Allbut) for the year ended December 31st last show a total revenue of £129,007, as compared with £107,026 in 1922. Working expenses amounted to £110,031 (£92,464), leaving a gross profit of £18,976 (£14,562). After deducting capital charges, &c., there was a net surplus of £10,974, as against a profit of £10,689 in the previous year. During the year £38,499 was spent on capital account. The amount of electrical energy sold increased from 14,719,537 to 18,949,497 kWh, and the connections increased from 14,516 to 16,528 kW.

Barrow-in-Furness.—ELECTRICITY SUPPLY.—The Electricity Committee has recommended that in a proposed application to the Electricity Commissioners for a Special Order for authority to extend the area of supply, the Dalton Urban Council's area be included. The Commissioners have sanctioned the purchase of second-hand converting plant, at a cost of £4,500, from Messrs. Vickers, Ltd., They state that they are not able at present to deal with the whole of the application for sanction to borrow £12,053, but have given sanction to a loan of £5,516 for mains.

Bath.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £47,000 on account of £80,000 applied for in connection with extensions to the electricity works. Additional information is required before the balance of the loan is dealt with. The Council has decided to supply electricity to Prior Park College, at an estimated cost of £3,235, provided an undertaking is given to install a minimum of 1,000 lamps.

Birmingham.—YEAR'S WORKING.—The report of the city electricity undertaking for the year ended March 31st last (Mr. R. A. Chattock, city electrical engineer) shows that the capital raised was increased during the year by £598,151, and the indebtedness was reduced by £156,000. The capital expenditure amounted to £614,405, mainly in respect of the works at Nechells and extensions of mains necessary to deal with new business. The total amount invested in the undertaking since its inception was £5,102,731, of which nearly £2,000,000 had been redeemed at March 31st. The quantity of electrical energy sold during the year was 171,150,000 kWh, being an increase of 31.68 millions as compared with last year, thus establishing a record output. The total revenue, notwithstanding the two reductions in the electricity charges during the year, was 6.16 per cent. higher than in the previous year. The prices charged for supplies were, on the average, 35.7 per cent. above the pre-war prices. Working costs had shown a further reduction during the year, and after meeting all capital charges, the surplus on the year's trading stood at £133,224, as against £107,160 for 1922-23. The special charges to be met amounted to £74,072, and, having regard to the heavy commitments in connection with the alterations to the plant at Summer Lane station, the Committee had decided to transfer the balance of the available surplus to the renewals and special expenditure account, after making an agreed contribution of £31,000 to the rates. The amount of the general reserve had been increased from £127,758 to £129,140 during the year, and the total reserves in the reserve fund and renewals and special expenditure account stood at £259,525. The expansion of the area served by the undertaking had called for large expenditure for feeders and distributing mains during the past year, and a further sum of £190,000 was required on capital account. In addition, £10,000 was required to meet the cost of another trunk line between Nechells and Summer Lane stations, which would form part of the link main shortly to be established between the undertakings of the Corporation and the Shropshire, Worcestershire, and Staffordshire Electric Power Co. under the terms of the South-West Midlands Electricity District Order, 1923. The Committee proposes, therefore, to apply for sanction to borrow £200,000 for the two purposes mentioned.

Blackpool.—LOAN.—The Corporation is applying to the Electricity Commissioners for sanction to the borrowing of £28,000 for electricity purposes.

Bolton.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £50,000 for mains.

Bradford.—LOAN SANCTIONED.—The Town Council has received formal sanction from the Electricity Commissioners to the borrowing of £1,710 for the erection and equipment of a transformer chamber at Peel Park, for which £2,710 was applied for. Consideration of the balance is deferred by the Commissioners pending further particulars as to the tender for the sub-station building. An estimate for the erection of a sub-station at Four Lane Ends has been amended to £3,550, including land and buildings.

Bredbury and Romiley.—SPECIAL ORDER.—The Urban District Council has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity in the district.

Burnley.—ELECTRICITY SUPPLY.—The Electricity Committee has instructed the electrical engineer to prepare a report on the cost of laying an interconnecting main from Burnley to Nelson.

PROTEST AGAINST COMMISSIONERS' DECISION.—As recently reported in our columns, the Electricity Commissioners have decided to permit the Lancashire Electric Power Co. to erect a new power station at Padiham, and not to allow the Burnley Corporation to proceed with a proposed new station at Simonstone. At the monthly meeting of the Town Council on June 4th this decision was vigorously criticised, and a resolution was unanimously passed in which it was described as being against the weight of evidence given at the Commissioners' inquiry. The Mayor suggested the use of Parliamentary influence to obtain the reversal of the decision.

Chertsey. — ELECTRICITY SUPPLY. — The Urban District Council has decided to obtain expert advice as to the advisability of the Council's exercising its right to take over the electricity undertaking of the Urban Electric Supply Co., Ltd.

Continental.—FINLAND.—According to a *Reuter* message, the Finnish Government has been authorised by Parliament to raise a foreign bond loan during the current year to a maximum amount of £2,000,000 for the development of Imatra power plant. Mr. Malmy, the director of the State water power department, has recently reviewed the position regarding this development. The available power from the rapids of Finland amounts to about 2¼ million h.p., of which not more than 8 per cent. has yet been harnessed. He estimates that by regulating the Vuoksi River it will be possible to obtain about 700,000 h.p. from the Upper River. So far only 14,000 has been made available. In connection with the Imatra scheme, the first installation will amount to about 79,000 h.p., and it is anticipated that this portion will be completed before 1928. Further additions to plant may be made in the future to bring the total capacity of the station up to 150,000 kW.

FRANCE.—A conference of officials has been held in the department of the Côte d'Or with a view to the establishment of a rural distribution network to serve some thirty parishes in the Sombernon district.

SWEDEN.—Uddeholms Aktiebolag is planning the regulation of the river Uvaan on which there are several waterfalls. The company's power system would then produce a maximum of 80,000 kW; as this would be more than the company could use for its own purposes the surplus power would be leased.—*Reuter's Trade Service* (Stockholm).

Crediton. — ELECTRICITY SCHEME. — The Urban District Council has received from Mr. T. W. W. Melhuish, consulting engineer, of Exeter, a detailed report on the proposed electric lighting scheme, the estimated cost of which is £10,250. The report has been forwarded to the Electricity Commissioners, together with an application for sanction to carry out the scheme.

Evesham.—ELECTRICITY SUPPLY.—In connection with the supply of electricity to the borough, the Shropshire, Worcestershire and Staffordshire Electric Power Co. proposes to establish a temporary plant at Evesham, which is expected to be in operation before Christmas.

Guildford.—OPPOSITION TO ORDER.—The Town Council and the Rural District Council have decided to lodge objections against a Special Order applied for by the Leatherhead and District Electricity Co., Ltd., authorising it to extend its area of electricity supply so as to include the parishes of East and West Horsley and East Clandon.

Irish Free State.—DUBLIN.—In the report of the Inquiry Commission appointed by the Free State Government with regard to the Corporation's administrative methods, it is stated that the Electricity Department is run at a profit, and £25,000, representing a portion of the profits, has recently been contributed to the relief of rates. The Corporation having been superseded by order of the Government and replaced by Control Commissioners, the electricity undertaking, with all other civic departments, is now under the control of this

body until all the municipal finance has been readjusted and placed on a basis which, it is hoped, will reduce rates. When that stage is reached, the Council will be reconstituted, and the electricity and other departments will again come under its control.

Kingston-upon-Thames.—YEAR'S WORKING.—The accounts of the electricity undertaking (borough electrical engineer: Mr. T. A. Kingham) for the year ended March 31st last, show a total revenue of £46,475, as compared with £41,890 in the previous year. Working expenses amounted to £23,532 (£21,600), leaving a gross profit of £22,943 (£20,289), to which was added the sum of £2,692, being income tax deducted from loan interest, &c. After deducting capital charges there was a net surplus of £10,205, as against a profit of £7,668 in 1922-23. The capital expenditure during the year amounted to £19,410, the chief item being £12,507 for machinery. The electrical energy sold increased from 1,888,134 to 2,394,010 kWh.

Littlehampton.—SPECIAL ORDER.—Application has been made to the Electricity Commissioners by the Sussex Electricity Supply Co., Ltd., for a Special Order authorising it to supply electricity in the urban district of Littlehampton and certain parishes in the rural district of East Preston.

Manchester.—YEAR'S WORKING.—The report of the Corporation electricity department (engineer and manager, Mr. S. L. Pearce, C.B.E.) for the year ended March 31st last shows a total revenue of £1,473,441, as compared with £1,394,625 in 1922-23. Working expenditure amounted to £722,136, as against £740,651, leaving a gross surplus of £751,305 (£653,974). Capital charges absorbed £641,150, and the net result was a surplus of £110,721, as compared with £128,714, which was placed to the reserve fund. The electrical energy sold amounted to 222,208,023 kWh, an increase of 36,564,189 kWh. Borrowing powers amounting to £181,200 were secured during the year, and the capital expenditure amounted to £692,123, being mainly in respect of the Barton scheme, bringing the total outlay upon the undertaking up to £7,903,190.

No additions were made to the generating plant of the city stations.

Two 2,500-kW motor converters have been added to the Dickinson Street d.c. distributing station, and a 33,000-V supply has been brought into this centre, and the first section of the new a.c. distributing station completed.

The Barton power station was formally inaugurated by the Rt. Hon. the Earl of Derby, K.G., on October 11th.

A new station, equipped with motor converters with a capacity of 2,500 kW, was brought into service during the year to provide a d.c. supply to a section of the city area, and a station at Longsight, equipped with 500-kW rotary converters, was also completed.

The following distributing stations are in course of construction, and will shortly be completed: Chorlton-upon-Medlock, Hulme, West Didsbury, and Gorton. The two last-named stations will be of the fully-automatic type.

In connection with the Barton supply the following a.c. 33-kV stations were put into commission during the past year: High Street, Stuart Street, Oldham Road "B," Moss Side (extension only), and Middleton.

During the year the department commenced to furnish a bulk supply to the Lancashire Electric Power Co., and arrangements have been completed for a similar service to the Stretford Urban District Council.

The proposals and quotation of the department for the supply of electrical energy to the London, Midland & Scottish Railway Co., in connection with the electrification of the Manchester-Oldham line, have been accepted by the engineers of the company, and now await the decision of the Board.

Nearly 48 miles of h.p. and l.p. mains were laid, bringing the total up to 639 miles.

Moreton.—PROPOSED ELECTRICITY SUPPLY.—Three electricity supply authorities have offered to give a supply to the district. The Wirral Council stated that the maximum charge would be 9d. per kWh, but it was hoped that it would not be necessary to charge the maximum. It could supply Moreton with electricity at from 2½d. to 1½d. per kWh. The Gayton Park Electricity Co. has applied for powers to supply the Wirral district, with electricity on the same terms as the Wirral Council. The charges of Wallasey, however, were considerably less than the other two. The Moreton Council has decided that the matter be held in abeyance for further consideration.

Nelson.—YEAR'S WORKING.—The report on the electricity undertaking (electrical engineer: Mr. G. F. Naylor) for the year ended March 31st last shows that since the installation of the new plant the electricity works has been run with marked success. The consumers totalled 3,024, and the gross profit for the year was £27,124, with a net profit, after deducting interest and sinking fund charges, of £10,168.

Newark (Notts.).—ELECTRICITY SCHEME REJECTED.—The Electricity Commissioners have refused the application of the Corporation for powers to erect a large generating station at Newark and to carry out a scheme of electricity supply in its area. At the inquiry at Newark a scheme for two 1,500-kW sets, at a cost of £100,000, was opposed by the Newark Property Owners' Association, the Newark Rural District Council, the Notts. and Derby Electric Power Co., and certain engineering and other firms. During the inquiry it was contended that the Notts. and Derby Power Co. had Parliamentary powers for the area, and if any supply was required it should be asked to give it. This view has been upheld by the Commissioners.

Reigate.—OBJECTION TO ORDER.—The Rural District Council has raised objection to an application by the Urban Electric Supply Co., Ltd., for an Order to supply electricity in the parish of Shaldon, on the ground that overhead wires should not be used. The Electricity Commissioners have granted a Special Order for supplying electricity to Lowfield Heath, and have dispensed with the consent of the Council, which has withheld owing to the proposed use of overhead lines.

Southport.—LOAN.—The Electricity Committee has recommended to the Town Council that application be made to the Electricity Commissioners for sanction to the borrowing of £3,250 for the provision of a new sub-station and mains.

Special Orders.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation Special Orders made by them authorising Mr. W. J. Glover to supply electricity in the urban district of Callington and part of the parish of Stoke Climsland, the Electrical Distribution of Yorkshire, Ltd., to supply electricity in the urban districts of Luddenden Foot, Marsden, Meltham, Mytholmroyd, Stainland, Clayton West, Emley, Farnley Tyas, Flockton, Kirkburton, Lepton, Skelmanthorpe, and Whitley Upper, and part of the rural district of Halifax, the Middlesbrough Corporation to supply in certain parishes in the rural district of Stokesley, and the Isle of Thanet Electric Tramways and Lighting Co., Ltd., to supply in the parishes of Westgate-on-Sea and Birchington.

Wivenhoe.—ELECTRICITY SUPPLY.—In connection with the proposed electricity scheme, the Electricity Commissioners have informed the Urban District Council that they are prepared to give their consent, provided the local undertakings are taken over and a supply of electricity is obtained from Colchester. Negotiations have been opened with Colchester Town Council for a supply of electricity.

Wolverhampton.—ELECTRICITY SCHEME.—The Staffordshire, Wolverhampton and Dudley Joint Hospital Board has decided that Prestwood Sanatorium shall be connected with the public electricity supply at an estimated cost of £1,200.

Worcester.—ELECTRICITY SUPPLY RESUMED.—The floods in the city have subsided, and the electricity supply and tramway services were resumed on June 4th.

York.—DISPOSAL OF PLANT.—The Electricity Committee has recommended to the City Council that the Diesel engines at the generating station, which were obtained from a German submarine, be sold at the best price obtainable. It was stated that these engines had involved the city in a loss of £20,000. It was not possible to proceed with the alterations at the electricity works until the engines were removed.

Tramway and Railway Notes.

Birmingham.—YEAR'S WORKING.—The accounts of the Corporation tramway undertaking for the year ended March 31st last show a total revenue of £1,337,093, which was a decrease of £76,436 compared with the previous year. The decline was attributed to the system of cheaper fares in operation. Operating expenses amounted to £928,875, a reduction of £61,000, despite the fact that an additional 1¼ million car-miles were run. The gross profit for the year was £408,218. The gross amount to be credited to profit and loss account was £451,662, it being made up as follows: Trams, £408,218; petrol omnibuses, £33,741; railless-cars, £8,237; other items, £1,466. The net profit was £231,647, and of this £52,134 was placed to reserve account, £152,513 to renewals fund, and the balance of £27,000 was contributed to the relief of the rates. During the year track renewals were carried out amounting to £117,700. In view of the continued growth of the tramway services, and the taking over of the West Bromwich tramways, it is proposed to spend £100,000 on the purchase of 50 new tramcars.

Canary Islands.—According to the *Revista de Economia y Hacienda*, the Belgian electricity and tramway companies which work various concessions in the Canary Islands are about to carry out a big scheme of amalgamation of their undertakings, with the financial help of the Bank of Brussels and the Bank of Liége. The Société d'Electricité de Las Palmas is about to increase its capital in order to absorb the Tranvias de Las Palmas and the Compañia de Electricidad y Tranvias de Tenerife.

Colne.—"ONE-MAN" CARS.—A Special Committee submitted a report on the tramway undertaking to the Town Council, on May 28th. The committee recommends that during certain hours of the day, when tramcars are run at a loss, a service of one-man operated cars be put into operation, and the engineer has been instructed to convert three of the existing double-deck cars into single-deck cars. It is estimated that by the conversion, the annual saving in operating costs will be approximately £3,000. It is also recommended that when new cars are purchased they should be of the "one-man" operated type.

Continental.—ITALY.—By a Royal Decree the Commissario Straordinario of the State Railways is authorised to hand over to private enterprise the electrification of the Voghera-Milano-Chiasso and Verona Brennero railways, the supply of electricity and the control and upkeep of the railways for a period not exceeding thirty years.

POLAND.—According to *Commerce Reports*, a group of French financiers is applying for a concession covering the electrification of certain railways in Poland. The proposal involves the electrification of the Cracow-Mattowitz line as a beginning, the construction of a hydro-electric plant on the San River, and the electrification of other lines.

Croydon.—RAILLESS CARS.—The Local Legislation Committee of the House of Commons has given its decision on certain local traffic problems in the Croydon district. The matter came before the committee in a Bill promoted by the Corporation seeking powers to run motor-omnibuses within the borough and on certain routes outside by agreement with other local authorities; and also to run railless cars on certain specified routes. The London General Omnibus Co. was the principal opponent, claiming that local routes could only be run at a loss and that the Corporation should not in those circumstances be allowed to compete with the company, which already ran a large number of through services in Croydon. Property owners in the residential Addiscombe district also objected to the railless cars proposed to be run along the main road from Lower Addiscombe to Shirley, on the ground that the amenities of the district would be seriously interfered with. Eventually the Committee decided to sanction all the proposed railless-car routes except that from Addiscombe to Shirley, but to refuse the motor omnibus powers. This will enable the Corporation to run railless cars on an existing tramway route which would otherwise require reconstruction and to extend in other directions. Further consideration of the Bill was deferred until June 17.—*The Times.*

Halifax.—TRACK RENEWALS.—The Tramway Committee has agreed with the West Riding County Council, which is relaying the main road at Hebden Bridge, that the Corporation shall relay the tramway track on the road.

Liverpool.—NEW CARS.—The Corporation has received the sanction of the Ministry of Transport to the borrowing of £50,400 for the provision of new tramcars.

Longridge-Hellifield Light Railway.—The Settle Urban District Council has voted £6,000 towards the Longridge-Hellifield light railway scheme.

Southport.—TRAMWAY EXTENSIONS.—The Town Council is applying to the Ministry of Transport for sanction to the borrowing of £18,500 for tramway extensions in Kew Road and Eastbourne Road.

Telegraph and Telephone Notes.

Australia.—NEW RADIO STATION.—The chain of radio communication across Northern Australia will be added to by the decision of the Postmaster-General (Mr. Gibson) to erect a station at Camooweal, in Queensland.—*Daily Mail.*

Chile.—TELEPHONE CONCESSION.—According to the *Financial Times* a new concession has been granted to the Chili Telephone Co., Ltd., for a term of 20 years.

Germany.—RADIO STATION DAMAGED.—An attempt has been made by a number of unknown men to destroy the radio station at Königswusterhausen, one of the biggest in Germany. The men succeeded in felling one mast, but the guards stopped further damage by firing their revolvers. The men escaped.—*Daily Mail.*

Italy.—TRANSFER OF TELEPHONES TO PRIVATE ENTERPRISE.—The Commercial Secretary at Rome (Mr. J. H. Henderson, O.B.E.) informs the Department of Overseas Trade that all the preparatory studies for the cession of the Italian telephone service have been finished, and the definite text of the conditions of transfer will be submitted by the commission to the Minister, the On. Ciano. The Administration has already entered into relations with the companies to which the service will be entrusted, but the definite transfer has not yet been effected. The urban telephones will be divided into five zones and ceded to an equal number of companies—two for North Italy, two for Central and South Italy, and one for the Islands. The concession companies will have some initial expenditure for the increase of plant, apparatus, and the introduction of the automatic system. The interurban lines will be ceded to one company because no one was willing to undertake the service for Central and South Italy.

New Zealand.—TELEGRAPH REVENUE.—The total postal and telegraph revenue in New Zealand for the first quarter of the current financial year was £690,210, compared with £642,044 for the corresponding period of last year.

United States.—HIGH-SPEED RADIO TELEGRAPHY.—Mr. M. A. Noss, chief engineer of the Telepost Laboratories, New York, has developed a high-speed radio telegraph receiving system which makes possible radio reception at speeds above one thousand words per minute. By means of recording adjustments reception may be carried on at any speed from ten words per minute upward. The signals are received on paper tape, and appear in simple dots and dashes identical with those appearing on Wheatstone received tape, except that instead of the marks being made by an inked wheel, the employment of chemically-treated tape permits the incoming signals in an amplifier circuit to register in dark lines easily readable. The system embodies a static reducing feature which permits of receiving clear signals through severe static conditions.—*T. & T. Age.*

Radio Notes.

Austria.—RADIO REGULATIONS.—Regular broadcasting is expected to commence on July 1st, a concession for the purpose having been granted to a group composed of banks and electrical firms. The Post and Telegraph Administration is to issue regulations on the basis of the contract which has been made.

Canary Islands.—BROADCASTING MONOPOLY.—French interests are seeking from the Spanish Government a monopoly of broadcasting, and of the sale and licensing of receiving sets throughout the Islands, according to Press reports.

Italy.—BROADCASTING LAW.—The *Gazzetta Ufficiale* No. 116 of May 16th publishes the text of a Royal Decree Law No. 655, which deals mainly with broadcasting, and introduces certain modifications into the existing legislation regarding wireless telegraphy and telephony. Section No. 655 provides that receiving apparatus must be stamped by the Italian Government before it can be put on the market, and the fees payable in this respect may be 300 per cent. higher in the case of imported apparatus, or apparatus assembled in Italy from imported parts, than in the case of apparatus manufactured in Italy. The full text of the translation of the law can be seen at the offices (Room 53) of the Overseas Trade Department.

Play Wanted.—PRIZE OFFERED.—The British Broadcasting Co. offers a sum of £50 for a new and original play for broadcasting, which must be submitted to it before August 1st.

Portugal.—BROADCASTING CONCESSION.—According to *Commerce Reports*, control of broadcasting is being sought by the British Marconi Co., which has obtained a concession from the Portuguese Government to operate broadcasting stations. This company is already active in Spain.

Contracts Open and Closed.

Open.

Argentina.—BUENOS AIRES.—August 25th. Department of Navigation and Ports. Electrical material, including insulators and insulating material, wires and cables, electric lamps and holders, telephone bells, mouthpieces and cords, dry cells, &c.*

Australia.—MELBOURNE.—September 15th. State Electricity Commission. Bushing insulators for 6,000-V, trifurcating boxes. (June 6th.)

SYDNEY.—July 28th. Municipal Council. A.c. and d.c. consumers' meters.*

Durham.—June 21st. Corporation. Electric lighting installation in the Council Chamber and offices, 38, Saddler Street; George Gregson, surveyor.

Egypt.—CAIRO.—October 30th. Egyptian State Railways, Telegraphs and Telephones. Automatic c.b. telephone exchange equipment and sub-station (subscribers' apparatus) at Cairo. Specification and set of drawings may be obtained at the office of the Administration's Inspecting Engineer, Queen Anne's Chambers, Broadway, Westminster, London, S.W.1.—*Reuter's Trade Service* (Cairo).

Irish Free State.—DUBLIN.—June 30th. Postmaster-General's Department. 400 wall-pattern telephones, with magneto, bell, and generator; 100 table pedestal pattern; 2,600 hand micro pattern, with press key; 1,000 table box pattern, with magneto, bell, and generator. (June 6th.)

Leeds.—June 18th. Electric lighting at York Road and Bramley Baths. Mr. W. T. Lancashire, city engineer, Municipal Buildings.

London.—INDIA STORE DEPARTMENT.—June 20th. Lead-sheathed, armoured, dry core cable. (May 30th.)

METROPOLITAN ASYLUMS BOARD.—June 18th. Automatic telephone system at Darenth Training Colony, Dartford, &c. (June 6th.)

June 18th. 144-tube economiser, engineering work for new central boiler house, drying machine, revision of laundry engineering arrangements, installing electric lighting and power wiring in boiler house and laundry, and covering boilers, steam, feed and suction mains, &c., with non-conducting composition at the South-Western Fever Hospital, Stockwell, S.W. (June 6th.)

(*Continued on page 971*).

Some of the Exhibits at Wembley.

Electromotors, Limited.

(Stand No. 82, Avenues 12 and 13, Bays 15 and 16.)

This company has specialised for some years in the production of industrial d.c. motors and dynamos, and a.c. motors. These have recently been re-designed, and the new ranges are shown in public for the first time.

The centre of the stand is occupied by a revolving turntable, upon which is mounted a large "Lo-thermo" motor similar to that illustrated in fig. 96. This is designed specially for use in acid fume and dust-laden situations. The additional radiating surface provided by the superstructure permits powers and speeds to be obtained which have hitherto been impossible with ordinary watertight motors. One of the larger d.c. motors shown is illustrated in fig. 97. This is provided with large oil-ring bearings. In the largest sizes the

Fig. 96.—A "Lo-thermo" Motor.

body and driving end bearing are split along the centre line to permit the easy removal of the armature. Fig. 98 illustrates one of the company's squirrel-cage a.c. motors. If improved starting conditions are required, automatic centrifugal clutches are fitted. In the wound-rotor type shown the brush gear and slip rings are so proportioned as to give infinitesimal wear when running under full-load conditions continuously, and brush-lifting and short-circuiting gear is obivated, unless specially desired, except in the larger sizes. A series of motors typical of the special designs which can be supplied to meet the various conditions of industry is shown; this includes pipe-ventilated, cowl-ventilated, watertight, &c., motors.

Two sizes of motor generator are also exhibited.

In addition to these exhibits the company has installed examples of its plant in other parts of the Exhibition. It was the main contractor for the electrical equipment of the "Never Stop" railway, and the model dairy in the Milk Pavilion, and other exhibitors are using the company's machines.

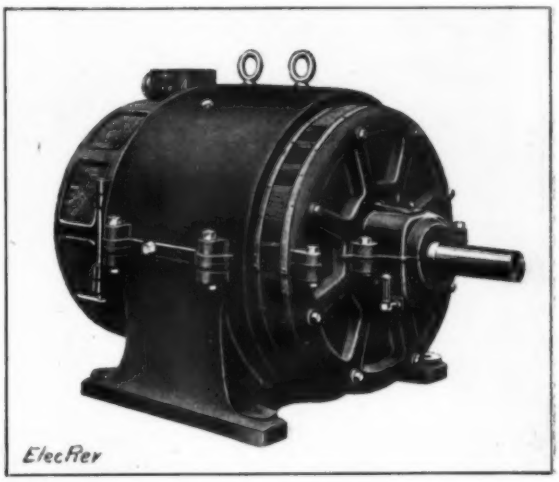


Fig. 97.—A Typical "Electromotors" D.C. Motor.

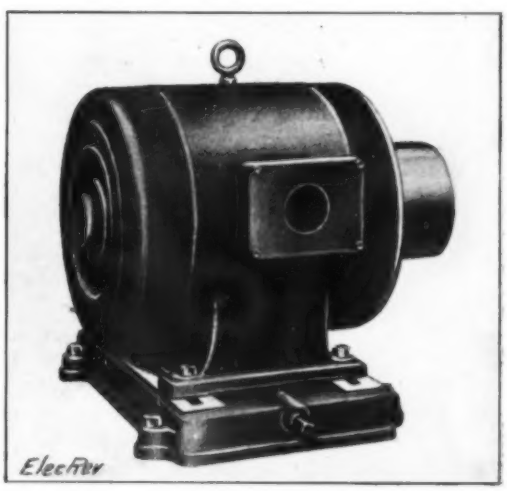


Fig. 98. An "Electromotors" Squirrel-cage Motor.

Messrs. Erskine, Heap & Co., Ltd.

(Stand No. 95, Avenue 13, Bays 11 and 12.)

This company has a number of interesting exhibits, including switchboards of the ironclad, cubicle, truck, and flat back types, together with circuit breakers, starters, instruments, oil switches, fuses, &c.

Cubicle switchgear is represented by a standard heavy type generator cubicle of the unit type, to which either extra generator or feeder panels can be added at any time, the doors giving access to this cubicle being mechanically interlocked with the main oil-immersed circuit breaker in such a manner as to make it impossible to gain access to the interior of the cubicle until all parts below the bus-bars are made "dead." Truck-type switchgear is represented by a standard "Erskine Heap" truck panel, the shutter arrangement of which is particularly interesting.

There are two rotary synchronisers in operation on the stand.

A range of direct-current circuit breakers is shown. These are of the loose-handle, laminated-brush type, their outstanding features being simplicity and sound mechanical construction. No springs whatever are used in their construction, the closing mechanism consisting of a double toggle action of ample size and simple direct action. No catches are used, which would be liable to wear and get out of order. They are provided with very long breaks, in addition to the magnetic blowouts, the break by itself being sufficient to open the circuit. Fig. 99 illustrates a 400-A breaker.

A three-unit ironclad-type board is shown, each unit being complete with its separate lowering gear and isolating chamber, the bus-bar chamber running along the top.

A panel is also shown mounted with various sizes of "cool handle" switch fuses, having a patented reinforcement, the contact jaws being of high conductivity hard drawn copper. The reinforcement makes it impossible for the jaws to be bent out of shape, and even in the event of their becoming softened by heat from the fuse wires, the patent reinforcement gives the necessary pressure to ensure good electrical contact under all conditions. One of these, a 500-A switch fuse, is illustrated in fig. 100.

Various types of a.c. motor starters of the star-delta, auto-

transformer (fig. 101) and rotor types are shown at the front of the stand. All these starters are fitted with a "free" or "loose" handle, so that, in the event of an overload occurring when in the running position, the starter in circuit cannot be held closed, as it trips quite independently of the handle. A stop is fixed as an integral part of the handle lever so that when this is pushed rapidly, as it should be, into the starting position, it is definitely checked there, and the operator cannot inadvertently over-run the position. When he requires to move it forward into the running position he frees the handle lever by depressing the button at the top of the handle. This enables him to pass forward again, rapidly, into the running position. A useful isolating arrangement is fixed to all these starters. This consists of an isolating plug, which is withdrawn when the tank is lowered; thus when the tank is removed for inspection purposes, all contacts and connections are automatically made dead, a separate switch for isolating the starter being unnecessary. This method of isolating also has the additional safeguard of preventing the current being applied to the starter until the tank is in position. It is not possible to break circuit at the plug contacts, as, when the tank is lowered, in the first part of its travel it mechanically operates the tripping gear, causing the starter to return to the "off" position.

The stator and rotor starters are designed on the same general lines as the auto-transformer starters, the resistances being mounted at the bottom of the tanks, while the stator and rotor contacts are mounted on the same drum, thus combining in one unit the double function of a separate stator switch and rotor starter, with perfect mechanical interlock between the two. To ensure that an unskilled operator does not start up a motor too quickly, these starters are fitted with a slow-motion device, which consists of a gate arrangement.

The moving-iron ammeters and voltmeters shown are also of the company's own manufacture. They are very accurate, being rendered "dead-beat" by an air dashpot of ample clearance, and of exceedingly light construction.

Other exhibits include three-phase oil circuit breakers with automatic trips, suitable for mounting on switchboards.

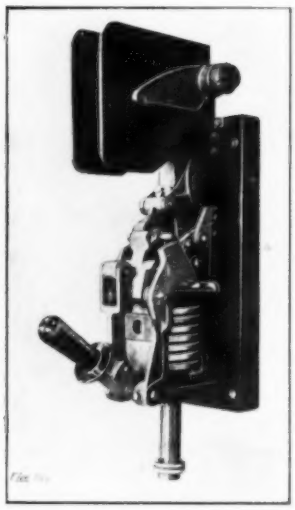


Fig. 99.—An "Erskine-Heap" 400-A Circuit Breaker.

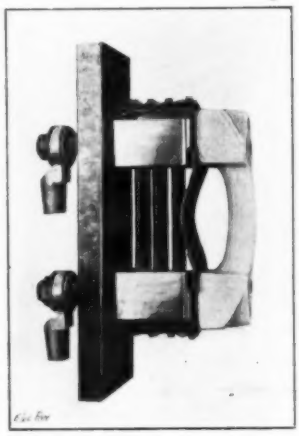


Fig. 100.—An "Erskine-Heap" 500-A Switch Fuse.

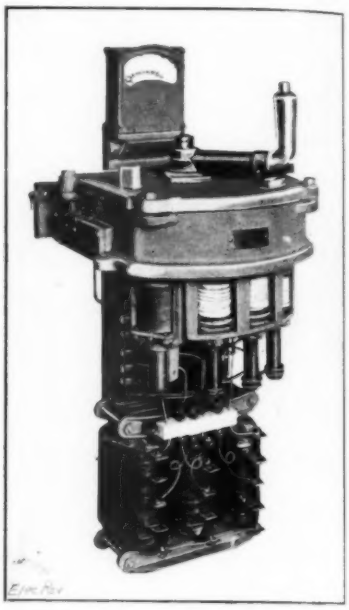


Fig. 101.—An "Erskine-Heap" Auto-transformer Starter.

Brush Electrical Engineering Co., Ltd.

(Stand No. 71, Avenue 11, Bays 7 and 8.)

Amongst the numerous exhibits of this firm, the Brush-Ljungström turbo-generator is the main attraction. The turbine is of the double-rotation, reaction type, each of the two rotors revolving in opposite directions; the relative blade speed is, therefore, twice the actual running speed, and as a result the efficiency in very high. Each rotor is coupled to an alternator, which are electrically connected together. A further unique feature is the method of erection. The two alternators are bolted to the turbine casing, and the complete turbo-generator is mounted on the condenser, thus dispensing with a bedplate and the foundations required by other types of turbo-generators. This method of erection is rendered practicable owing to the light weight and symmetrical arrangement of the machine. The general principles of construction

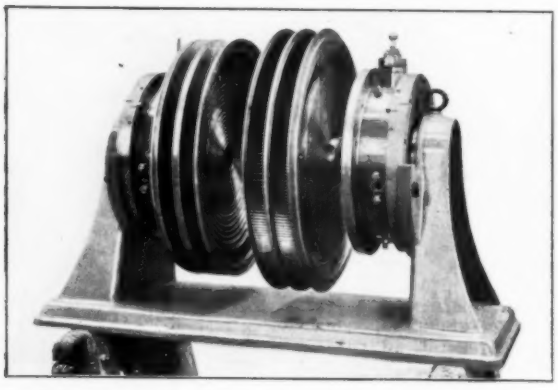


Fig. 102.—Blade System of 1,500-kW Brush-Ljungstrom Turbine.

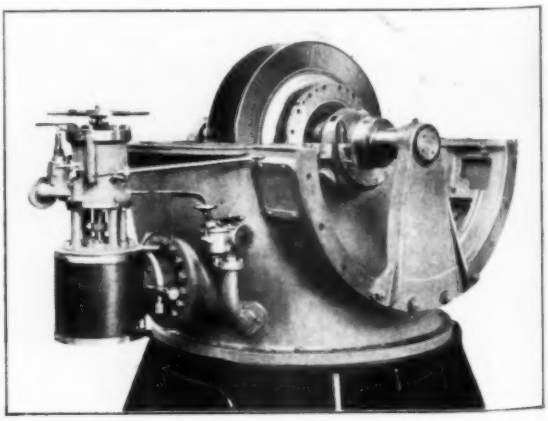


Fig. 103.—Blade System and Bottom Half-Casing of 5,000/7,000-kW Brush-Ljungstrom Turbine.

and working are clearly shown by the exhibit of the complete blade system of a 1,500-kW turbine (fig. 102). This consists of the two blade rotors, each with its steam chest, erected so as to show the intermeshing of the blade rotors, the labyrinth packing disks, and other parts.

The main exhibit is the bottom half-casing and blade system of a 5,000/7,000-kW turbine (illustrated in fig. 103). In this case the final expansion is dealt with by radial blading.

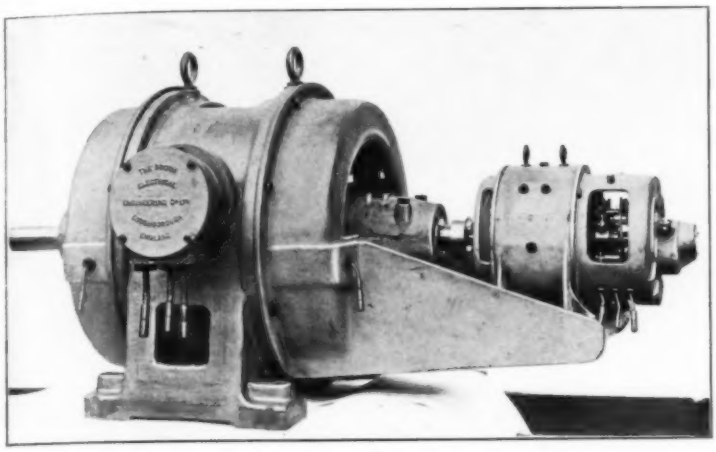


Fig. 104.—Self-starting 100-H.P. Synchronous "Brush" Motor.

One of the most difficult problems in the design of steam turbines is that of dealing efficiently with the large volume of steam at the exhaust end, and the solution is invariably something in the nature of a divided flow of the steam, which involves increased cost and space occupied. The design of the Brush-Ljungström turbine, however, lends itself very easily to divided flow for the last stage, since the radial flow of the steam through the axial blading can readily be changed to an axial flow in both directions through radial blading provided on each of the blade disks. This arrangement of the radial blading secures the advantages of double flow without any increase in dimensions; the exhibit shows the guide blading in the bottom half-casing, and in order to show the radial blading the top half of the guide blading has been removed.

Other turbine exhibits include complete blades in various stages of manufacture; blade disks and rings, showing the method of construction; an oil tank and pump and a combined stop and governing valve for a 5,000-kW turbine. Photographs on the stand illustrate Brush-Ljungström plant of all sizes installed in generating stations both in this country and abroad; the Brush Co. has completed upwards of 125 sets of plant, totalling more than 315,000 kW.

An interesting exhibit is the Brush-Delas ejector for extracting air and creating and maintaining the vacuum in condensers. It is a component part of the generating plant, and its main features are similar to other types of steam-jet air-extraction apparatus, but it differs in that the diffuser is water cooled, which feature is claimed to render it economical of operating steam.

The rotor for a 1,500-kW Brush-Ljungström turbo-generator is also shown. It consists of a solid steel forging, the slots to receive the winding being milled in its periphery. The windings consist of heavy copper strip wound on edge; they are completely formed before being inserted in the slots. The insulation is so arranged that there is a layer of mica between any two turns and also between the coils and iron, the mica being protected by a minimum quantity of oiled linen and leatheroid.

A new development, which was described in our issue of May 30th, is a patented winding for low-voltage alternators. An example of this winding is shown, while the outstanding feature of the firm's transformer exhibit is a 300-kVA, 3-phase, unit fitted with a patented tapping switch that was described in our issue of May 16th. Other transformer exhibits include a 400/40,000-volt testing transformer. The dynamo and motor section comprises machines of various types. An example of the self-starting, salient-pole, synchronous motor is exhibited in the form of the 100-b.h.p., 440-volt, 3-phase, 50-period, unity power factor machine illustrated in fig. 104.

A 50-h.p., 900-r.p.m., 480-volt enclosed ventilated d.c. motor is shown, also a 75-h.p., 725-r.p.m., protected slip-ring induction motor, a separate exhibit being the brush gear for slip-ring synchronous motors with short-circuiting and brush-lifting gear. The range of liquid starters manufactured by the Brush Co. is represented by a type "N" unit.

Lancashire Dynamo & Motor Co., Ltd.

(Stand No. 76, Avenues 11 and 12, Bays 19 and 20.)

A feature of the interesting exhibit on this stand is a deck caulking machine, fig. 105, driven by a 3-h.p. "Lancashire" d.c. motor, which entirely overcomes the many difficulties presented by the operation of mechanical caulking, by means of a device known as the "extended seam." This is a hollow guideway forming an extension of the seam to be packed. Within the tapered opening formed by the adjustable wall the oakum is compressed by the hammer, and passes downward and enters the seam in a partially compressed state, where it is easily driven into place by the point of the hammer. The hammer is tapered roughly to correspond with the wall of the "extended seam," and the

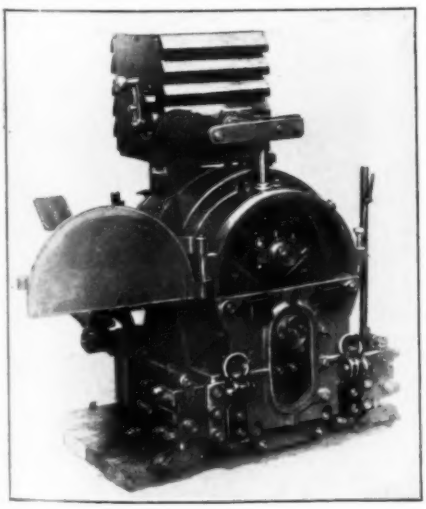


Fig. 105.—"Lancashire" Deck Caulking Machine.

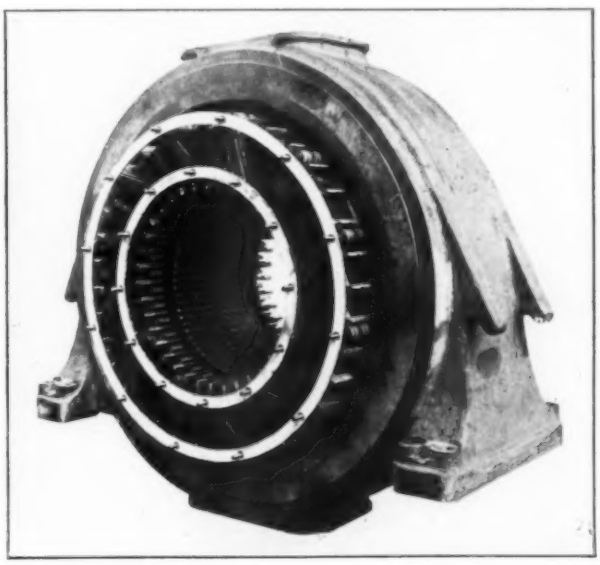


Fig. 106.—Stator of "Lancashire" Turbo-Alternator.

vertical reciprocating stroke is calculated to compress the material into a thread of suitable dimension. The width of the hammer can be made to suit any size of seam; it is driven direct from the flywheel mounted on the motor shaft. On the top of the motor there is mounted a reversing controller, which allows of speed variation in either direction. For the purpose of traversing the machine along the deck, the base is fitted with fluted rollers, which are adapted to grip the deck and travel in either direction. The caulker is kept in alignment with the seam by means of tapered wheels placed within the seam, one set in front of and one behind the hammer. These are designed to meet the many irregularities found in the best laid planking. The depth of blow given by the hammer is regulated by a hand arrangement placed in front of the gear casing. The oakum thread is wound upon a bobbin which carries about 450 ft., the supply to the tool being automatic.

For the purpose of moving from seam to seam, the machine is fitted with a cross travel gear operated by a foot lever.

The equipment weighs approximately 10 cwt., and will caulk upwards of 40 ft. per minute, equalling the work of about 20 men, whilst only one attendant is required.

The "Lancashire" alternator for direct coupling to steam turbines embodies the results of many years of practical experience and research. The stator windings are solid impregnated, after which each coil is wrapped in a Haeffly machine, by means of which the mica wrapping is pressed on to the coil whilst both coil and mica are subjected to heat. The rotary motion of the Haeffly machine removes every vestige of air from the coil, and ensures that the conductors are covered with a solid mass of mica. The stator end windings, illustrated in fig. 106, are securely braced against movement in all directions. The rotor and shaft are made from one solid steel forging, out of which the necessary slots are machined. The critical speed is kept well above the normal running speed. The flat copper strips which form the field coils are insulated by mica, and these coils are pressed into the slots by hydraulic pressure, through the medium of a brass strip.

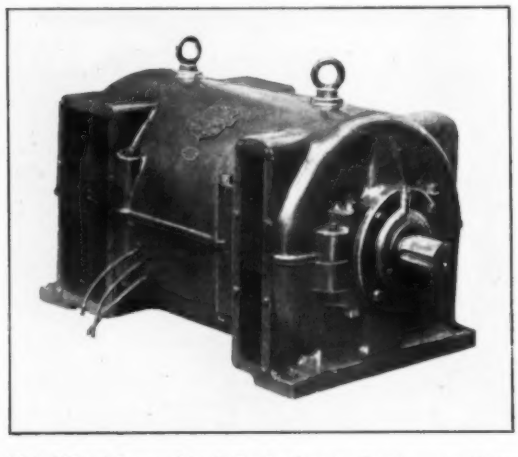


Fig. 107.—"Lancashire" Squirrel-cage, Steel-works Motor.

When the coil is pressed home into the slots, this strip springs into notches, and securely holds the coil under pressure whilst the slot wedges are being fitted into the slots. This method of fitting the coils is patented, and ensures that during manufacture the windings are subjected to a higher permanent stress than they are ever subjected to when under working conditions. The end windings are held in position by mica-insulated end bells of chrome nickel steel, and the method of building the rotor converts it into a solid drum of steel, copper, and mica.

To withstand the severe conditions met with in steel works, the squirrel-cage live roll motor, type M.T. 6, illustrated in fig. 107, has been developed by the company. This motor, which follows accepted steel works practice, in so far that the stator case is split, enabling the whole rotor and stator to be removed quickly, is said to be unique in its internal construction. Roller bearings are fitted of exceptionally large size. The motor has been designed to be started by having full voltage thrown on it when standing, or full reverse voltage being thrown on it when running at full speed. The only insulation which it is possible to damage is on the stator, where it can be thoroughly impregnated, and where it is not subjected to stress. The rotor is practically a steel drum with solid copper bars fitted so that they cannot possibly move, and uninsulated end rings. The motor is designed, for various duties, to develop up to twice full-load starting torque with 2½ times full-load current. It is capable of being started, stopped, and reversed under full-load conditions from 600 to 1,000 times per hour, with a normal temperature rise, the full control being accomplished by means of a simple triple-pole change-over switch. The motor only requires three leads to it, instead of the usual six, this fact becoming of great importance on such machines as charging machines, where the number of trolley wires necessary to the motors becomes a very serious item. There is, of course, no space required for bulky resistances.

The wide range of d.c. and a.c. generators and motors made by the company is well represented on the stand. Special attention may be directed to the "Lancashire" squirrel-cage motors, for which high torque and ease in starting are claimed, so that this simple robust and inexpensive type can replace the slip-ring type in almost all cases where speed control is not required. A typical example is illustrated in fig. 108; such motors have been installed in sizes upwards of 300 b.h.p.

CRYPTO EXHIBITS.

The Crypto Electrical Co., Ltd., which for some years has been associated with the Lancashire Dynamo & Motor Co., Ltd., is exhibiting a number of machines on the same stand. The brushgear, commutator, and terminal arrangement are exhibited as separate units. The brushgear, of the box pattern, is particularly robust, and by an ingenious arrangement the

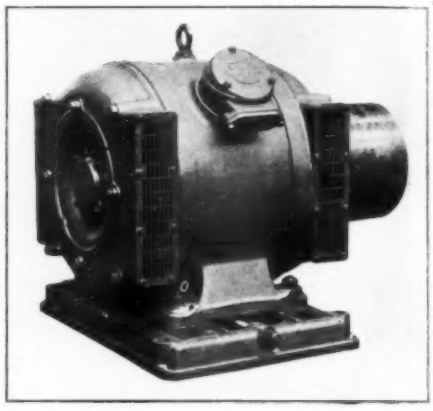


Fig. 108.—Standard Squirrel-cage Motor, Protected type.

brushes can be inserted or withdrawn without altering the brush spring tension in any way. The machines are provided with exceptionally large ball bearings for their size. Ease of withdrawal is a feature of the design of the bearing and housing.

The machines vary in power from ¼ to about 15 horse-power, and are suitable for all industrial purposes. The small types when used on single-phase can be fitted with an automatic centrifugal rotor switch, which obviates the necessity of an external split-phase starter.

There are one or two generators on the stand, suitable for battery charging, country-house lighting, arc welding, &c. For charging small batteries a Crypto d.c. rotary transformer is shown. There is also a combined a.c. to d.c. machine, consisting of an a.c. motor and d.c. generator mounted on the same shaft, and the Crypto patent commutating rectifier, of which hundreds have been sold during the last few months.

Fig. 109.—"Crypto" Rectifier.

The C.B. type shown is capable of an output up to 50 volts, 5 amperes, and the A.F. rectifier can be seen under working conditions on the stand; it is used in conjunction with a small switchboard, on which is mounted an automatic cut-in and cut-out for the protection of the cells should the supply fail at any time. The machine itself is protected by an automatic centrifugal switch fitted to the rotor.

A complete meter testing plant is shown consisting of a motor coupled to a special alternator with six slip rings, giving one-, two-, or three-phase currents, which are transformed up to suitable voltages by means of static transformers.

Three switchboard panels are exhibited, one to control a generator, another a battery and lighting panel, and the last a variable-speed motor panel for wall and floor fixing.

Contracts Open and Closed.

(*Continued from page 966.*)

HAMMERSMITH.—June 16th. Electricity Department. H. and l.p. paper-insulated cables, 100-kW and 250-kW air cooled and 1,000-kW oil cooled transformers. (June 6th.)

METROPOLITAN WATER BOARD.—July 2nd. Three electrically-driven reciprocating air compressors and two electrically-driven centrifugal pumps, piping, &c., at Walton pumping station. (June 6th.)

ST. PANCRAS.—June 24th. Electricity Department, l.p. switchboards. (See this issue.)

Meltham (near Huddersfield).—June 18th. Colne and Holme Joint Hospital Committee. Installation of electric lighting in the buildings and grounds, Fever Hospital. Mr. D. J. Bailey, Clerk to the Committee, Yorkshire Bank Chambers, Huddersfield.

New Zealand.—WELLINGTON.—August 14th. City Council. One electrically-driven multi-stage turbine pump complete.*

Portsmouth.—June 25th. Board of Guardians. Electric fittings during three months, commencing July 1st, 1924. Clerk to Board of Guardians, St. Michael's Road.

Paisley.—June 16th. Education Authority. Works, including electric lighting installation in connection with special classes school annexe, Paisley. Schedules from Executive Officer, Paisley.

Salford.—June 16th. Electricity Committee. Ventilating plant. Particulars from borough electrical engineer, Frederick Road, Pendleton.

Scarborough.—June 18th. Board of Guardians. Installation of storage battery, 300-Ah capacity, complete, and booster set. Mr. J. W. Read, clerk to Board of Guardians, 14, Dean Row.

South Africa.—JOHANNESBURG.—June 23rd. Municipal Council. Electric lamps and watertight fittings for street lighting.*

CAPE TOWN.—July 7th. Municipal Council. 1,000 a.c. meters, house service type.*

UNION OF SOUTH AFRICA.—July 31st. High Commissioner. Automatic telephone exchanges for Parktown, Mayfair, Hatfield, and Kloof.* (See this issue.)

Uruguay. — MONTEVIDEO. — July 8th. State Electricity Works. L.p. switchboard and accessories.*
July 9th. Copper wire and cable.*
July 24th. 82,000 metres of v.i.r. wire and cable.*

Walthamstow. — July 2nd. — Electricity Department. Natural draught cooling tower. (See this issue.)

York.—July 1st.—Electricity Department. One 6,000-kW turbo-alternator with condenser, h.p. switchgear, electric crane. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Aberdeen.—Electricity Committee. Recommended:—
Circulating-water system from the River Dee to the electricity station in Dee Village Road (£5,876).—Mr. W. Tawse.

Birmingham.—The Corporation has placed with Vickers and International Combustion Engineering, Ltd., an order for a complete pulverised fuel installation for the Nechells power station. It will comprise six Vickers-Spearing boilers with Lopulco type combustion chamber; four bunkers; four gravity type dryers; four Raymond roller pulverisers; two compressors; six groups of Lopulco feeders; 24 Lopulco burners. Strict efficiency guarantees have been given. The contract is the largest of its kind placed in this country. Mr. R. A. Chattock, the city electrical engineer, recently visited many pulverised fuel installations in Canada and the U.S.A.

Burnley.—Electricity Committee. Accepted:—
Rotary converter and transformer (£4,049); switchgear for a 1,000-kW rotary converter (£833).—Metropolitan-Vickers Electrical Co., Ltd.
Board of Guardians. Accepted:—
One 60-kW generating set (£638).—Belliss & Morcom, Ltd.

London.—ST. MARYLEBONE.—Electric Supply Committee. Supply of underground cables during the year ending April 30th, 1925:—

	L.p. £	E.h.p. £
W. T. Glover & Co., Ltd.	4,283	1,738
Union Cable Co., Ltd.	4,280	1,749
Callender's Cable & Construction Co., Ltd.	4,271	1,755
Siemens Bros. & Co., Ltd.	4,248	1,774
British Insulated & Helsby Cables, Ltd.	4,207	1,705
Pirelli-General Cable Works, Ltd.	4,172	1,763
Western Electric Co., Ltd.	4,152	1,739
Johnson & Phillips, Ltd.	4,146	1,740
W. T. Henley's Telegraph Works Co., Ltd.	4,128	1,735
Enfield Cable Works, Ltd.	4,062	1,736
Hackbridge Cable Co., Ltd.	3,971	1,579

The Committee recommends acceptance of the tender of the Hackbridge Cable Co., Ltd., for l.p. cables and that of the British Insulated & Helsby Cables, Ltd., for e.h.p. cables.

De-aerating plant and extraction pumps (£2,895).—G. & J. Weir Ltd. (recommended).
Absorption tower and control equipment for dealing with canal circulating water (£315).—Patterson Engineering Co. (recommended).
Switchgear in connection with the Hampstead bulk supply (£1,665).—Ferguson, Pailin, Ltd. (recommended).

Maidstone.—Town Council. Accepted:—
50-kVA transformer (£96).—Hackbridge Electric Construction Co.

Middlesbrough.—Corporation. Accepted:—
Erection of two electricity sub-stations at Nunthorpe (£280).—Stephen Coates, Ltd.
Cables in connection with the new Fallow Street sub-station (£654).—British Insulated & Helsby Cables, Ltd.
1,300-kVA transformer (£265).—Swedish General Electric, Ltd.
Three switch pillars (£162).—Metropolitan-Vickers Electrical Co., Ltd.

Salford.—Electricity Committee. Accepted:—
E.h.p. switchgear at Frederick Road power station (£9,444).—Metropolitan-Vickers Electrical Co., Ltd.
Earthing resistance and switchgear for the protective devices (£676).—Metropolitan-Vickers Electrical Co., Ltd.
6,215 yd. l.p. cable (£1,911).—W. T. Glover & Co., Ltd.

Tramways Committee. Accepted:—
350 tons B.S.S. No. 7 rails (£3,386).—Bolckow, Vaughan & Co., Ltd.

Forthcoming Events.

Incorporated Municipal Electrical Association.—Monday, June 16th, to Saturday, June 21st. At Chester. Annual Convention.

Radio Society of Great Britain.—INFORMAL MEETING OF THE TRANSMITTER AND RELAY SECTION.—Friday, June 20th. At the Institution of Electrical Engineers, Victoria Embankment. At 6.30 p.m. Discussion on "Tuning Coils," to be opened by Mr. A. J. Cooper.

Notes.

The Channel Tunnel.—The Prime Minister has promised to receive at an early date a deputation from the House of Commons Channel Tunnel Committee, introduced by Sir William Bull, the chairman. A canvass recently made shows that nearly 400 members of the House of Commons are prepared to support the construction of a tunnel. In some cases approval of the scheme is subject to a favourable decision by the Committee of Imperial Defence. In the three political parties, only 73 names appear as opposed to the project, and 84 members have not yet announced their views.—*Daily Mail.*

Technical Teachers' Conference.—The fifteenth annual conference of the Association of Teachers in Technical Institutions was held at Newcastle-at-Tyne from June 7th to 11th. In his presidential address, Mr. F. C. Clarke, B.Sc., A.R.C.S., A.M.I.E.E., referred to the growth of the Association and the important part which it was playing in the industrial life of the country. The membership varied from those who conducted the highest studies in pure and applied science to those who taught young girls to sew. Speaking of the attitude displayed towards such associations as theirs, Mr. Clarke said that teachers' associations should be regarded in the same light as other recognised professional associations. Men were still suspicious of the expert, but this feeling of mistrust was passing. Later in his address Mr. Clarke said that considerations of the future demanded a vigorous healthy Britain, with its young people properly educated and skilled in the crafts and industries which this country was capable of supporting and extending. Our captains of industry must be something more than financial or business men only; they must have a sure knowledge and experience of the technique of their industry, based on a sound technical training, and possess a wide human outlook and sympathy with their workers, by virtue of that same training and education. A large part of the address was devoted to an appeal for equality of opportunity for the boy who proceeds to the technical school as compared with one who goes to a "secondary" (non-technical) school.

The Worcester Floods.—The Three Counties Show, which is held by the Herefordshire, Worcestershire, and Gloucestershire Agricultural Societies, has lately been increasing in popularity, and this year was to have taken place on June 3rd, 4th, and 5th upon a tract of ground known as "Pitchcroft," in the city of Worcester. The River Severn runs along the one side of the ground, but there were no records of a flood having covered the ground in June during the last 200 years. On May 31st, the bulk of the machinery and other exhibits for the show were on the ground, and the cattle and livestock began to arrive. Messrs. Abell & Smith's Electrical Co., Ltd., Worcester, had four complete lighting sets in running order, several pumps, motors, electric heating, cooking, and other apparatus ready for exhibition, and several local contractors were represented as well as the large manufacturers. The Shropshire, Worcestershire, and Staffordshire Power Co. had joined the Worcester Corporation in an exhibit demonstrating the application of electricity to agriculture, and altogether the show promised to be one in which electricity was well represented.

On Sunday morning, June 1st, the river began to rise rapidly, and the lower part of the show ground was soon under water. The show was abandoned, and the livestock cleared from the ground, but it was not anticipated that the

flood would reach the machinery section, which stood some 5 or 6 ft. higher than the rest of the ground, although a few firms, including Messrs. Abell & Smith's, began to move their more delicate exhibits from that section about mid-day. The Worcester Corporation had two large transformers installed upon its stand, which it succeeded in getting them on to a Tillings-Stevens lorry, but, unfortunately, in attempting to get it off the show ground, the vehicle stuck in the mud and was finally submerged. By cutting a way through the back of the enclosure and using horse-drawn vehicles, Messrs. Abell and Smith's succeeded in removing all their electrical machinery, although in many cases the windings were not more than half an inch above water when they were reached and carried bodily to safety, working at this time in about two feet of water.

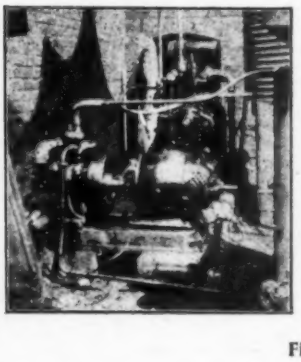
The accompanying illustrations were reproduced from photographs taken the following morning. Fig. 1 is a view of the "machinery in motion" section of the show, while

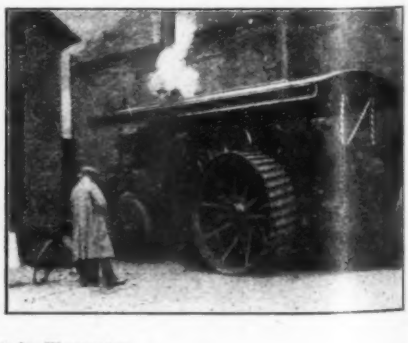
Figs. 1 & 2.—The Flooded Worcestershire Show Grounds.

fig. 2 shows the trades section, from which Messrs. Abell and Smith's radio apparatus was fortunately all recovered in time. An oil engine on the firm's stand actually floated on a hastily-constructed raft of railway sleepers, but not quite clear of the water, but a 14-h.p. Crossley oil engine was entirely submerged. On Sunday evening the water entered the Corporation electricity works and shut down the plant, as already briefly reported. The supply failed early on the Monday morning, and as the local waterworks use electric pumps, there was a serious water shortage, and such water as was available was of a reddish brown colour owing to the filter beds being flooded. This unhappy state of affairs was, however, alleviated later on in the day by using a petrol tractor in a high part of the town to drive a motor as a generator and using the current thus provided to drive one of the waterworks pumps. In the meantime, on Monday morning, Messrs. Abell & Smith's began to consider what could be done to give some sort of a supply until the electricity works could be got going again. They offered a lighting set to the Post Office to keep the telephones going, but found that it could make arrangements for an emergency set of its own. The Infirmary could also carry on with its own emergency lighting arrangements, and the firm therefore undertook to do what it could for others who were asking for a supply.

By 4 o'clock it had two lighting sets running on its own premises, and was supplying a local kinema, both for the projector and interior lighting, an hotel, a club, and a few other smaller consumers, and a little later on was driving a motor for a refrigerating plant to prevent the food stored from being spoilt. Plant rescued from the show ground the night before was also used to run another kinema. Fig. 3 shows the two sets on the firm's own premises, which consisted of a 10-kW "Aster" set and a 1½-kW "Austin." Fig. 4 shows a Boulton & Paul "Electrolite" set running a kinema. By the next day the company had installed a dynamo driven by a gas engine to run linotype machines for one of the newspapers, and had arranged with a local showman to run another kinema, as shown in fig. 5. By midnight on Tuesday the electricity works had got some plant running again.

The course of events at the Corporation Electricity Works will be described in our next issue.





Figs. 3, 4 & 5.—Temporary Generating Plant in Worcester.

Appointments Vacant.—Clerk of the Works for a steam and electrical installation in a Midlands Mental Hospital. Maintenance Engineer for the Worcester Corporation Electricity Works. Resident Engineer, Boiler House Superintendent, Turbine House Superintendent, for the County of London Electric Supply Co.'s Barking power station. Instructors in electrical engineering and electrical installation for the Evening Classes at Kingston-on-Thames Technical Institute. Draughtsman (£6) for the Eccles Corporation Electricity Department. Armature Winder (£300+) for the Government of Tanganyika. Instructor in Electrical Installation work for the Tottenham Polytechnic. (See our advertisement pages to-day.)

Educational. — UNIVERSITY COLLEGE, UNIVERSITY OF LONDON.—On Wednesday last week, a reception was held by the Chairman of the University College Committee (Viscount Chelmsford), the Vice-chairman (Sir John Bradford), the Provost (Sir Gregory Foster), and the Dean of the Faculty of Engineering (Prof. E. G. Coker), and the visitors inspected the new engineering drawing office and laboratories. A number of demonstrations were given, including the action of cutting tools, illustrated by the photo-elastic methods devised by Prof. Coker, tests of materials, electrical measurements, &c., and a number of excellent drawings executed by students were on view. Prof. J. A. Fleming gave a short lecture on the appliances used in broadcasting the King's speech at Wembley and described the valve which he had developed in those laboratories.

The equipment of both the electrical and the mechanical engineering laboratories has been greatly improved and extended, and the accommodation enlarged by the addition of two floors to the engineering building. Some £54,000 has been received towards the completion of the building, of which the L.C.C. has contributed £10,000, Viscount Cowdray an equal sum, and the family of the late Mr. Charles Hawksley £3,000. The amount still required is £27,000, of which Viscount Cowdray will contribute £10,000 when another £17,000 has been subscribed.

ROBERT BLAIR FELLOWSHIPS.—The London County Council has published particulars of the Robert Blair Fellowships in Applied Science and Technology. These fellowships, of which two will be awarded each year, carry a monetary grant of £450. Applicants must be British subjects, at least 21 years of age, preference being given to students of engineering science, and to those who have completed a course of study in London institutions, or have been identified with the London teaching service. The successful candidates will be required to undertake an advanced course of study or research in the Dominions, the United States, or other foreign countries. The Education Officer, County Hall, London,

S.E.1, will supply further particulars to anyone interested.—*The Times.*

Exhibition of Inventions.—An exhibition of inventions will be held by the Institute of Patentees (Inc.) from August 11th to 16th, in Aldwych House, Kingsway, London. Prizes will be awarded for the best inventions, including two prizes for women. Of the eight sections two will be devoted respectively to "electrical" and "wireless" inventions. Amongst the judges are several well-known engineers.

The Great Organ at the B.E.X.—The organ which has been erected in the Stadium at the British Empire Exhibition is said to be the largest portable organ in existence; it cost £10,000 to build, and weighs 30 tons. There are 5 manuals, with 75 stops and over 3,000 pipes, of which the largest is 32 ft. long. The action is electro-pneumatic throughout, and over 85 miles of insulated wire has been used in its construction, which involves the use of 5,000 electric contacts.

The World Power Conference.—The opening reception of the World Power Conference will be held on Monday, June 30th, at the Conference Halls, British Empire Exhibition. H.R.H. the Prince of Wales has graciously consented to be present and to welcome delegates from the 35 participating countries. This function will take place in Hall 1 at 3 p.m., and it is hoped that in addition to the official delegates there will be a large attendance of enrolled members of the Conference.

The official banquet will take place in the evening of Monday, June 30th, at the Queen's Hall, Langham Place, London, at 7 for 7.30 o'clock. The President, the Rt. Hon. the Earl of Derby, K.G., will preside.

Engineers and others interested in enrolling as members and attending the Conference should communicate with the Secretary, World Power Conference, 36, Kingsway, London, W.C.2.

Applicants should give the names of the Technical Institutions or Societies of which they are members.

An Electromance.—Two rival testers met in a magnetic field, and so high was the tension it almost induced a potential difference between them. Suddenly each espied a sparkling volt tripping from segment to segment. Seeing them, she leapt headlong into a rushing torrent.

"Ah, the hapless maid!" cried one, "would a rotary converter?"

"It autotransformer," replied the other.

"Why do you swim so fast?" both called out.

"Because the current is behind me—alas, I am wattless—I mean hapless."

"Oh! ϕ" cried the testers.

"Hurry to the Wheatstone Bridge," said one.

"Wattmeter!"

"A-mmeter! But don't run too fast and trip on the breakers."

"Look!"

"Y point?" he delta blow.

"There are fifty cycles; take one and hurry."

"I dare not, it belongs to a policeman."

"That is merely a copper loss."

"Sine, wave to her, throw megaline."

The maid was saved, and lay choking with reaction.

One sought to raise her "Impedance"—impudence, I mean.

"My father was an 'M.P.*'" she said.

"I cannot stand this heavy torque," said the tester, "the load on the line is too great, there'll soon be a heavy drop."

"Yet I will rectifier," said the other; "there is my leaky grid, let us seek a field less excited."

"R.M.S.," she lisped, with some reluctance, "say no more, do not make the poor solenoid."

"Is your answer still in the negative?" he asked tenderly.

"I am not positive," said she.

"Fickle maid, you have changed your polarity."

Looking back at his rival, he cried, "You go and kilowatt while I take megohm."

By A. L. Paget, B.Sc., in the *Faraday House Journal.*

The Railway Shopmen's Strike.—At midnight on June 4th an unofficial strike, organised by a committee claiming to represent unskilled and semi-skilled employés in the workshops and power stations of the London Electric Railways and the Great Western Railway, was commenced, and on the following day the services were seriously disorganised. The railway officials and the National Union of Railwaymen were confident that few of the men would stop work, but in the course of that day the number rose to something like 2,000 in London and 1,700 in Cardiff, elsewhere in South Wales and Birmingham. The strikers demanded an increase of wages by 10s. a week, with a minimum of £3; the war bonus to be merged in the basic wage; one week's holiday with pay; and a guaranteed day and week, the advance in pay to be conceded to all the employés in the departments covered by Awards Nos. 728 and 648 of the Industrial Court. The railway companies pointed out that the demands could not be considered, as they were not put forward in the manner agreed upon with the unions concerned, and the N.U.R., declining to support the strike, stated that recently it had been decided to inaugurate a national programme for the revision of the wages of all railway employés. Forty Tube stations were closed, and the supply of power from Lot's Road generating station was considerably reduced, 450 men having ceased work there. The tramway services fed from Lot's Road were at first considerably reduced, but restored later. Wood Lane power station was shut down, and the Central London Railway also for a time.

On Friday night members of the "craft" Unions concerned held a meeting and gave their support to the strike, and the Electrical Trades Union called out those of its members who were shopmen on the London Electric Railways—not including the power-house employés. Cardiff power station men refused to leave work.

In the meantime the Associated Society of Locomotive Engineers and Firemen formulated a demand that the classification of drivers should be withdrawn and the guaranteed day for Sunday re-established for enginemen. The managers pointed out that these matters were settled by agreement in January last.

By Saturday the number of men on strike had reached 7,000, but reduced train services were maintained, and during the week-end many men returned to work. There was a stoppage on the District Railway on Monday for 25 minutes owing to an overload on the power station, but the services improved during the day, and a number of stations were reopened. Many London shopmen were out, because the shops were closed, not because they struck; they were receiving no strike pay, as the strike was unofficial.

The Metropolitan and L.N.E. Railways were not affected by the strike, and carried enormous numbers to the British Empire Exhibition.

Many uniformed men returned to work on Tuesday and Wednesday, but the chief difficulty of running more trains was the shortage of power. The Electrical Trades Union, which recognised the strike immediately, called a meeting of the railway shop stewards in the London district on Wednesday with the object of taking further action if thought fit. This is a grave threat to involve all power stations, but a significant event was a second appeal by the unofficial strike committee to the Ministry of Labour that it should act as an intermediary between that committee and the Union, the authority of which the strikers has set aside. Sir D. Shackleton undertook to act upon the request, but with the distinct understanding that the Ministry should convey the representations only and should not attempt to influence the Union's decision.

Canadian Research.—The Canadian Manufacturers' Association has approved the creation of a National Institute of Scientific Research for the Dominion. A fund of £200,000 is to be raised.—*Daily Mail.*

Inquest.—The Manchester District Coroner, Mr. R. S. Rodger, returned a verdict of "accidental death" on June 3rd at the inquest on Charles Lever (30), driver of an electric haulage engine in the No. 3 pit of the Bridgewater Colliery at Walkden, who was found dead underneath the engine, having apparently been shocked at 400 volts. The Coroner remarked that there had been no breach of the mines or factory legislation, and he thought the man's death was due to a simple error on his own part.

Radio at Sea.—The P. & O. liner, *Maloja*, which left Tilbury on June 6th for Sydney, is the first ship to carry the new type of Marconi installation for ships' lifeboats, fitted with a directional receiver. This receiver enables the crew of the lifeboat to ascertain the position of other ships and direct them towards it.—*The Times.*

*NOTE.—M.P. is the commercial designation of a multipolar d.c. machine.

Institution Notes.

Institution of Electrical Engineers.—NORTH-WESTERN STUDENTS' SECTION.—The Students' Section has had a successful session, the membership having increased by over 14 per cent. In addition to the 11 meetings, the students have paid six visits to works.

MERSEY AND NORTH WALES (LIVERPOOL) CENTRE.—The report of the Committee for the 1923-24 session shows that committee meetings have been held on nine occasions, and seven ordinary meetings have been held, the average attendance being 97, which does not take into account the audience of 675 present on February 18th for the popular lecture on "Radio Reception," by Prof. Marchant, D.Sc., when over 1,000 applications for tickets were received. The first dinner of the Centre was so much appreciated that the Committee is of the opinion that it should become an annual event. The meeting on April 14th was a distinct departure from the usual form, and the exhibits, showing the latest developments in connection with electric lighting, heating, cooking, and also radio reception, were very much appreciated, particularly by the many ladies present. The number of members transferred to other districts or who have been removed from the list for various reasons this session is 58, while the total membership is 476. The total expenses for the session amounted to £173, including the students' total of £29.

STUDENTS' SECTION (LIVERPOOL).—Seven ordinary meetings have been held, two being joint meetings with the University of Liverpool Engineering Society and the Students' Section of the Liverpool Engineering Society. The average attendance has been 28, and four visits to works were organised, the average attendance totalling 14. The Committee regrets to note a falling off in the attendance of members of the section. Considering that the membership is 177, the Committee feels that the members are not taking that sustained interest in the section which is desirable.

Association of Mining Electrical Engineers.—ANNUAL MEETING.—The annual meeting was opened on Tuesday, June 10th, and Wednesday and Thursday were spent at the British Empire Exhibition, where the Palace of Engineering, the Model Colliery, the Government exhibit, and the Colonial Pavilions were visited. To-day there will be a council meeting, the rest of the members being free to make their own arrangements in the morning, but in the afternoon the annual general meeting will be held at 2.30 p.m., and in the evening at 7.30 p.m. there will be a dinner at the Midland Grand Hotel, concluding the official programme.

Institution of Heating and Ventilating Engineers (Inc.).—The summer meeting will be held at the Langham Hotel, Regent Street, London, on Tuesday, June 24th, commencing at 9.30 a.m. A paper on "Research Work. Its Past, Present and Future," will be read by Mr. E. Herring, and one on "Oil Fuel as applied to Central Heating," by Mr. A. F. Baillie (of Shell-Mex, Ltd.), will be read and discussed. There will be a visit to the British Empire Exhibition on Thursday, June 26th. It is hoped to present to the members at this meeting a preliminary publication of Tests of Heat Emission from Radiators, prepared by Mr. Alcwyn A. Jones.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The celebration of the Jubilee of MR. HENRY ALABASTER, Chairman of the ELECTRICAL REVIEW, LTD., which, it will be remembered, took place in London at the end of February, had a happy sequel when, at the invitation of Mr. Alabaster, the directors and the staff and employés of all departments of the company recently visited Eastbourne by road. While the journey down from London was not altogether free from the displeasure of the elements, the latter made amends in the afternoon, and before the charabancs set out for home, brilliant sunshine flooded the countryside, adding to the glory of an exceptional springtime beauty. After luncheon had been partaken of at the Cavendish Hotel, under Mr. Alabaster's genial chairmanship, the party adjourned to the pier and other points of interest for brief enjoyment of relaxation and pleasures of an interesting kind. On re-assembling for tea, they were joined by Mrs. Alabaster and Mrs. G. H. Alabaster, also by two dainty little ladies, the Misses Alabaster (grandchildren of the chairman), who, as they passed along the tables temptingly offering chocolate favours to the guests, introduced a pretty and a homely final touch to the Eastbourne part of the day's programme.

At St. Annes, on June 4th, Miss BERTHA BEECHAM was married to Mr. W. FIRTH, of Lytham. Bride and bridegroom were both employed at the St. Annes Electricity Works.

Dartford Urban Council has decided to increase the salary of the electrical engineer from £600 per annum to £750 by yearly increments of £50.

Mr. R. WARING, M.I.E.E., who is retiring under the age limit from the position of superintending engineer, P.O. Engineering Department, Glasgow, recently received some valuable gifts as a mark of appreciation from the staff. Mr. Waring went to Glasgow from London in 1918, and has completed 48 years in the service.

After nearly 26 years as vice-principal of the Crystal Palace School of Practical Engineering and a like period as principal, Mr. J. W. WILSON, M.Inst.C.E., M.I.Mech.E., is retiring at the close of the present term. He will be succeeded in the principalship by his brother, Mr. MAURICE WILSON, A.M.Inst.C.E., F.S.E., who has been vice-principal for the past 26 years. The school was founded by Mr. Wilson (senior) in 1872.

Birkenhead Tramways Committee recommends that the salary of the Tramways Manager be increased from £650 to £750 per annum, with bonus, as from February 1st last, owing to increased duties in connection with the motor omnibus services.

Mr. W. A. CHRISTIANSON has joined the engineering sales staff of Messrs. Hick, Hargreaves & Co., Ltd., of Bolton. He was formerly on the contract department staff of the British Thomson-Houston Co., Ltd., Rugby, and recently with Messrs. W. H. Allen, Sons & Co., Ltd., Bedford.

The directors of the London and North-Eastern Railway Co. at their last meeting appointed Mr. H. W. H. RICHARDS, M.I.E.E., electrical engineer. He will be responsible to the chief mechanical engineer for all electrical engineering work in connection with traction, power, and lighting in the southern area, and will act in an advisory capacity to him in connection with such work for the rest of the system.

Last week Lord Knutsford, chairman of the London Hospital, presented a framed testimonial, the gift of the Carnegie Hero Fund, to Mr. ERNEST HARNACK, a worker in the X-ray department as long ago as 1897, when the subject was in its infancy and its dangers were not known. By reason of his zeal Mr. Harnack ultimately lost both his arms. In spite of many warnings he stuck to his post and did excellent work, discovering, in conjunction with others, means for the protection of operators. The Carnegie Hero Fund has made Mr. Harnack a grant of £75 a year, which will be added to the £285 a year given by the Hospital.

By the retirement of Mr. ARTHUR EDGAR COTTERELL there is severed an association with the Telephone Service which dates back to its inception in this country. When, as a boy, he entered the employ of the Midland Telephone Co. in November, 1879, the first telephone exchange in this country had only been opened three months, and the Manchester and Liverpool ones about two months. Birmingham followed before the end of that year. In April, 1886, Mr. Cotterell was appointed district manager at Hanley for the National Telephone Co., which had absorbed the Midland Co., and in June of the same year was made manager for the Birmingham district, a position which he held until the year 1900, when he was promoted to be assistant provincial superintendent for the Midlands. In July, 1908, he was transferred to London to a similar position in the southern province. On the transfer of the telephones to the State Mr. Cotterell was attached to the secretary's office at the General Post Office amongst a small group of advisory officers, where, in addition to other important duties, he acted as chairman of the Departmental Committee which was charged with the duty of compiling the service instructions—a voluminous work. He now retires, having attained the age of 60, but, happily, is in excellent health. He was the writer of numerous articles and papers on telephony, telegraphy, terrestrial magnetism, and astronomy. He assisted in the supervision of the laying of the first underground telephone cable and tested it on completion. He also devoted much attention to the question of superimposing telephone circuits on existing ones, thereby increasing their carrying capacity. On Monday last week a farewell meeting was held at G.P.O. North, at which Mr. R. A. Dalzell, the director of the Telegraph and Telephone Services, made some handsome presentations to Mr. Cotterell from his old colleagues and various members of the staff.

Mr. J. DOUGLAS WATSON, test room assistant at Aberdeen Corporation electricity works, was presented with a gold watch by the staff and employés on leaving the department after twelve years' service, to take up the duties of assistant mains superintendent to the Preston Corporation electricity department. Mr. J. Alex. Bell made the presentation. Mr. Leslie Edwards, of the Newcastle-on-Tyne Electric Supply Co., has been appointed to fill the vacancy.

The recommendation to increase the salary of Mr. J. A. BELL, city electrical engineer, from £1,018 to £1,050 has been approved by the Aberdeen Corporation.

Mr. E. W. ARMSTRONG, mains foreman in the Barrow Corporation Electricity Department, has been presented by the staff and employés with a canteen of stainless cutlery on his completion of 25 years' service in the department. The presentation was made by Mr. H. R. Burnett, the Borough Electrical Engineer, at a social function at the Imperial Hotel.

Mr. H. WILSON, A.M.I.E.E., distribution engineer to Paisley Corporation, who previously held similar positions at Croydon and Maidstone, has been appointed electrical engineer to the Ashford (Kent) Urban District Council, and will take up his duties on July 14th. He has instructions to submit to the Electricity Commissioners a scheme for electricity supply in the area controlled by the Council.

The Northampton Town Council has increased the salary of the general manager of the tramways, Mr. J. F. CAMERON, from £400 to £500 per annum. With bonus the salary will amount to £697.

On a proposal from the Dundalk Electricity Committee that the salary of Mr. SPALDING, manager of the electricity undertaking, be reduced by 8 per cent., *viz.*, £46, to £525 per annum, it was decided by the Urban Council to ask the Committee to reconsider the matter. Mr. Spalding had reminded the Committee that in September, 1920, his salary had been increased from £500 to £575. That the undertaking had gone on successfully was evident from the fact that during the past three years it had contributed £1,500 in relief of rates. If he were worth £250 in 1912, when the station output was less than 200,000 kWh per annum, he should be worth at least £575 now, when the output was six times as great. In addition to his duties as engineer and manager, he was responsible for the finances and accounts, and he also acted as secretary to the Committee. He was the only official of any important undertaking of the kind in Ireland whose responsibilities covered such a wide range, and he was at present relatively the lowest-salaried chief official of any Irish electricity undertaking. Finally, in 1920 he received only half the increase he was entitled to. In the circumstances he could not agree to any reduction. Several members paid cordial tribute to Mr. Spalding's services, and Mr. McGahon recalled the promises made to Mr. Spalding when he transferred his services from Galway to Dundalk.

Obituary.—On Friday afternoon last, at Islington Cemetery, we laid to rest the remains of Mr. FRANK ROBERT BANTIN, who joined the commercial staff of the proprietors of this journal when quite a lad, 29 years ago. He had served the ELECTRICAL REVIEW faithfully for the whole of his business life, and his loss is keenly felt by his associates. He had been ailing for some months, and an operation was performed on May 26th, but he passed away in hospital on Sunday, June 1st. Floral tributes were sent by the company, the chairman, and several of the directors personally, by his colleagues in the various departments at 4, Ludgate Hill, and by the composing staff at Hosier Lane, and all of these were represented at the funeral. We tender our heartfelt sympathy to the widow and son in their sore bereavement.

New Companies Registered.

Radio Experts, Ltd. (198,407).—Private company. Registered June 3rd. Capital, £500 in £1 shares. To carry on the business of wireless, mechanical, and electrical engineers, manufacturers of and dealers in wireless goods and equipment, electric, magnetic, galvanic and other apparatus used in connection with the generation, distribution, supply and employment of wireless broadcasting or receiving, &c. The subscribers (each with one share) are:—H. E. Ridley, 61, Angle Street, Middlesbrough, accountant; J. H. Pearson, 53, Westbury Street, Thornaby-on-Tees, clerk. H. E. Ridley signs documents as director. Qualification, 10 shares. Solicitor: S. Lithgow, 85, Albert Road, Middlesbrough. Registered office: 35 and 37, Dundas Mews, Middlesbrough.

Orbit Traversing Fan Co. (198,418).—The Orbit Traversing Fan Co., Ltd., was registered on June 3rd with a nominal capital of £50,000 in £1 shares. The objects are:—To enter into (a) an agreement with Veritys, Ltd., for the acquisition of certain patents, Nos. 203,475 and 208,022, and rights therein specified relating to oscillating fans and of the interest of the said company in the trade mark or name "Orbit"; and (b) a licence between this company and Veritys, Ltd., and to carry on the business of mechanical and electrical engineers, &c. The first directors are:—G. Verity, J.P., M.I.E.E., 6, Wyndham House, Sloane Gardens, S.W.1 (chairman, Veritys, Ltd., and director of Metropolitan Electric Supply Co., Ltd.); J. F. Lister, C.M.G., M.I.E.E., 279, Hagley Road, Birmingham (director of Veritys, Ltd., and Spencer (Melksham), Ltd.); A. E. M. Taylor, the Pond House, Codicote, Herts., solicitor (director of Midland Coal Products, Ltd.). Minimum cash subscription, 2,000 shares. Qualification, 100 shares. Solicitors: Eland, Nettleship & Butt, 4, Trafalgar Square, W.C. The registered office is at 45, Kingsway, W.C.2.

Palermo Gas, Light and Power Co. (198,303).—Registered as a "public" company on May 29th, with a nominal capital of £50,000 in 1s. shares. The objects are:—To carry on the business of a light and power company; to act as gas, water, electrical, and mechanical engineers; to supply gas, electricity, galvanism, and magnetism, or water or other power; to erect gasometers, pipes, mains, cables, wires, connections, &c. The first directors are:—C. B. Tully, Grey House, Carlton-on-Trent, gas engineer; H. L. Keed, 6, Charles Street, Berkeley Square, W. (director, Kerr, Stuart & Co., Ltd.); W. B. Anderson, 40-42, Norfolk Street, Strand, W.C.2, chartered accountant. Minimum cash subscription, 7 shares. Qualification, 1,000 shares. Remuneration, £250 each per annum (chairman £300) and 5 per cent. of the net profits remaining after 10 per cent. dividend is paid, divided between them. Solicitors: Ashurst, Morris, Crisp & Co., 17, Throgmorton Avenue, E.C.2. No notice of situation of registered office was filed at the time of incorporation.

British Wolmuth "Sanawaves" Co., Ltd. (198,298).—Private company. Registered May 29th. Capital, £5,500 in 5,000 10 per cent. non-cumulative participating preference shares of £1 each and 10,000 ordinary shares of 1s. each. To adopt an agreement with G. Wolmuth & Co., Aktiengesellschaft and Alfred Hurter, providing for the acquisition by the company of an agency for the sale of the apparatus known as "Sanawaves," together with the benefit of the trade mark No. 437,838 in Class 11, and to carry on the business of manufacturers of and dealers in galvanic, electrical, chemical, anatomical, surgical, and scientific apparatus and materials, manufacturers of and dealers in medicines and preparations, chemists, &c. The first directors are:—A. Fischer, Furtwangen, Baden, manufacturer; A. Hurter, 69, St. George's Road, Westminster, S.W., consulting engineer; H. R. Summers, 68, Killieser Avenue, Streatham Hill, S.W.2, manager. Remuneration as fixed by the company. Solicitors: Sugden & Hextall, 36, King Street, E.C.2. Registered office: 27, Soho Square, W.1.

British General Radio Co. (Retail), Ltd. (198,251).—Private company. Registered May 28th. Capital, £100 in 1s. shares. To carry on the business of wireless engineers, manufacturers of wireless apparatus, including radio valves, crystals, valve, crystal and other receivers, spark, continuous wave, and other transmitters, batteries, &c. The first directors are:—G. B. Hinks, A.M.J.I.E., A.M.I.R.E., 74, Hendford, Yeovil, Somerset, engineer (permanent managing director); Florence S. M. Hinks, Bridge Close Farm, Hardington Mandeville, Yeovil, Somerset. Remuneration as fixed by the company. Registered office: 30, Middle Street, Yeovil, Somerset.

G. Andrews & Co. (Boston), Ltd. (198,351).—Private company. Registered May 31st. Capital, £1,000 in £1 shares. To carry on the business of electrical engineers, &c. The first directors are:—H. Sanders, 124, Lincoln Road, Peterborough; F. C. Smith, 93, Lincoln Road, Peterborough. Qualification, 10 shares. Remuneration as fixed by the company. Secretary: Ethel Lunn. Registered office: 16, Cumbergate, Peterborough.

Official Returns of Electrical Companies.

Ward Services, Ltd.—Particulars filed of £1,200 debentures authorised April 28th, 1924, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Electrical and Allied Instrument Manufacturing Co., Ltd.—Debenture dated May 10th, 1924, to secure £350, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: S. T. Hoskin, 153, Fleet Street, E.C.

Krasa & Co., Ltd.—Debenture dated May 7th, 1924, to secure £175 13s. 7d. and further advances charged on the company's property, present and future, including uncalled capital. Holder: C. Tofts, Holt, Farnham Common, Bucks.

East Anglian Electricity, Ltd.—Debenture dated May 20th, 1924, to secure £1,450, charged on the company's undertaking and property, present and future, subject to any debentures previously issued and still outstanding. Holder: Lt.-Col. H. W. Goodall, Stinsford House, Dorchester.

Luminograph Co., Ltd.—Issue on May 27th, 1924, of £200 debentures, part of a series already registered.

British Battery Co., Ltd.—Satisfaction in full as from March 21st, 1924, of debenture dated June 7th, 1915, securing £300.

Bray, Markham & Reiss, Ltd. (74,871).—Return dated December 31st, 1923 (filed April 10th, 1924). Capital, £20,000 in £1 shares. 17,080 shares taken up. £16,080 paid. £1,000 considered as paid. Mortgages and charges, nil.

National Conduit and Cable Co., Ltd. (59,251).—Return dated December 31st, 1923 (filed April 1st, 1924). Capital, £1,000 in £1 shares. All shares taken up. £7 paid. £993 considered as paid. Mortgages and charges, nil.

Oxford Electric Co., Ltd. (34,685c).—Return dated March 19th, 1924. Capital, £175,000 in 20,000 ordinary and 15,000 preference shares of £5 each. 20,000 ordinary and 11,000 preference shares taken up. £122,550 paid on 13,200 ordinary and 11,000 preference shares (including £1,550 paid on 310 ordinary shares forfeited). £34,000 considered as paid on 6,800 ordinary shares. Mortgages and charges, £100,000.

Mather & Platt, Ltd. (60,387).—Return dated March 13th, 1924. Capital, £2,500,000 in 40,000 preference shares of £10 each and 2,100,000 ordinary shares of £1 each. 40,000 preference and 1,363,660 ordinary shares taken up. £630,660 paid on 29,200 preference and 338,600 ordinary shares. £1,133,000 considered as paid on 10,800 preference and 1,025,000 ordinary shares. Mortgages and charges, nil.

Lancashire United Tramways, Ltd. (87,044).—Return dated March 11th, 1924. Capital, £200,000 in £1 shares. 192,878 shares taken up. £7 paid. £192,871 considered as paid. Mortgages and charges, £546,500.* Deferred debenture stock issued, having no charge over the assets of the company, £83,330.

*A further £40,000 stock has been deposited as security for possible advances.

Northampton Electric Light and Power Co., Ltd. (28,640).—Return dated February 29th, 1924. Capital, £350,000 in 10 "A" and 340,990 "B" shares of £1 each. 10 "A" and 289,990 "B" shares taken up. £290,000 paid. Mortgages and charges, £150,000.

Return of allotments made up to April 8th, 1924, shows a further 3,133 "B" shares allotted for cash.

Notting Hill Electric Lighting Co., Ltd. (25,921c).—Return dated March 11th, 1924. Capital, £301,352 10s. in 2,998 cumulative preference and 17,002 non-cumulative preference shares of £10 each and 27,050 deferred shares of 1s. each. 2,998 cumulative preference, 11,402 non-cumulative preference, and 27,050 deferred shares taken up. £145,352 10s. paid. Mortgages and charges, £7,900. Ditto guaranteed jointly by this company and the Kensington and Knightsbridge Electric Lighting Co., Ltd., under the powers of the Kensington and Notting Hill Electric Lighting Companies Act, 1899, *£293,244.

Kensington and Knightsbridge Electric Lighting Co., Ltd. (26,193).—Return dated March 20th, 1924. Capital, £350,000 in 50,000 ordinary, 10,000 first preference, and 10,000 second preference shares of £5 each. 21,000 ordinary, 10,000 first preference and 10,000 second preference shares taken up. £179,840 paid on 15,968 ordinary, 10,000 first preference, and 10,000 second preference shares. £25,160 considered as paid on 5,032 ordinary shares. Mortgages and charges, £140,000. Ditto, guaranteed jointly by this company and the Notting Hill Electric Lighting Co., Ltd., under the powers of the Kensington and Notting Hill Electric Lighting Companies Act, 1899, *£300,000.

*The discrepancy between these two amounts appears to be accounted for by the fact that the Notting Hill concern has deducted from the total £6,756 first debenture stock redeemed and cancelled, while the Kensington company has not deducted the amount.

Electric Sign Co., Ltd. (45,610).—Return dated April 16th, 1924. Capital, £5,000 in £1 shares. 2,000 shares taken up. £1,000 paid. £1,000 considered as paid. Mortgages and charges, nil.

City Notes.

British Thomson-Houston Co., Ltd.

Mr. H. C. Levis presided at the annual meeting held on June 4th at the offices, Crown House, Aldwych. He said that on the whole the report was satisfactory in view of the general trade conditions which existed during 1923. They had been able to make depreciations somewhat in excess of the previous year, pay all interest charges, also the dividends on the preference shares, to recommend a dividend of 6 per cent., less tax, on the ordinary shares, and to increase their reserves. The value of orders received exceeded the amount for 1922, but the output by the factories was somewhat less, due to a considerable amount of the orders being received too late to allow of completion within the year. That was reflected in the balance-sheet in the account comprising apparatus, &c., finished and in process of manufacture, which had increased by nearly £600,000. The improvement in business had been maintained during the five months of this year. The volume on hand was again high, and for the present, at least, was increasing. If business continued to expand it was only a question of time when further capital would be required. That, of course, would be a satisfactory position, as growth was what they desired. The expenditure on plant and equipment during the year amounted to over £200,000. It would be of interest to note that the floor space of their various factories amounted to about two million square feet, and the number of their employés was about 11,000. After referring to the financial results, which were set out in the report already published in the ELECTRICAL REVIEW, the speaker said that last year he mentioned the fact that they participated in the formation of the Power Securities Corporation, Ltd., and they had reason to believe that it would be a successful enterprise. The result of the first year's working of that company was very satisfactory, and they had every confidence that it would continue to achieve its objects. Having referred to the company's exhibit at Wembley, the chairman said it had not been his custom to comment at any great length on general conditions, but a year ago he ventured to predict an improvement in the electrical industry, and the conditions to-day justified that hope. Keen competition continued both at home and abroad, and he saw no prospect

of its falling off yet, notwithstanding that the results were satisfactory, and the credit, as was always the case, was principally due to the hearty efforts of the company's employés. A substantial portion of the orders received by the company had come from abroad, principally from the British Dominions. The World Power Conference, which was shortly to be held in London, was one of the most important current events in the electrical world, and great credit was due to the British Electrical and Allied Manufacturers' Association and its officials, particularly its director, in organising the Conference, which would be attended by important and representative delegates from all parts of the world. Its deliberations should be helpful in stimulating the electrical industry everywhere, and, because it was held in London, it was probable and natural that its effects would be felt in this country sooner than elsewhere.—Earl Buxton seconded the motion, which was carried unanimously.

Anglo-Argentine Tramways Co., Ltd.

Sir G. A. Touche, Bt., presided at the annual meeting held on June 3rd, and in the course of his speech he reviewed the statistics as to traffic, traffic receipts, operating expenses, and other matters. There was a reduction in gross receipts owing to the reduced fares, notwithstanding the larger number of passengers carried, of £45,197, and an increase in expenses owing to the heavy loss on exchange and the larger business done, amounting to £146,587, so that the reduction in net receipts compared with the previous year was £191,784. In the previous year the amount carried to net revenue account was £1,182,994, and represented an inadequate return on the capital employed. This year it was only £991,210, plus £15,285 for interest on investments and transfer fees, making £1,006,495. The standing charges for interest and sinking funds, and the annuity to the City Tramways Co. were £666,686, leaving a surplus of £339,809. The dividend on 5½ per cent. first preference shares required £176,000. The dividend on 6 per cent. second preference shares required £183,000, a total of £359,000. The earnings of the year were £339,809, being short of the amount required to pay these dividends by £19,191. This shortage had been met by a transfer of £20,000 from the contingency reserve of £175,000, and the reserve was now reduced to £155,000. They were disappointed that another year had passed leaving them still unable to report a settlement of the tariff question. They opened negotiations well in advance of the expiration of the three years' term. These negotiations had for their basis the introduction of a very moderate and inexpensive scheme of sectional and zonal fares. In conjunction with the Lacroze Co., their formal petition was presented to the Municipality of Buenos Aires in the early part of January last year. When it was obvious that a new settlement could not be reached within the time available (although the delays were not due to them) they asked that the existing arrangement should be continued, pending an agreement of new terms. This most reasonable request was refused against the advice of the Intendente, and without even a short delay to prepare for the change. The refusal, which seemed to have astonished the Council itself, was hailed in some quarters as a victory over foreign capital. Foreign capital had been the great ally of Argentina in the development of its wonderful resources. It was, of course, an economic fallacy that any country could be benefited by alienating capital. "But we have no monopoly of economic wisdom. Have we not politicians at home who seem obsessed by hostility to British capital?"

The chairman proceeded to show that the position of affairs was retarding developments which were urgently required. How could anyone raise the necessary capital if they were not allowed an adequate income? Proposals had been submitted on which they had striven to reach a common understanding. The scheme had been considered by a special technical Commission of engineers and accountants. The report of the Commission was issued in September, but it still awaited ratification. A majority of the members of the Council seemed to be personally hostile to the company. The speaker stated the various reasons why they were still hopeful that a settlement would be reached. The world had not yet recovered from the fever of wars, and they must be patient.

Automatic Telephone Manufacturing Co., Ltd.

Sir Alex. Roger presided at the annual meeting, held at Liverpool on June 5th. He said that during 1923 they had been able to maintain steady production undisturbed by industrial disputes such as hampered the activities of 1922. The all-important development for 1923 was the adoption by the General Post Office of the Strowger automatic telephone system for London. A contract had been signed with the company for initial orders for this purpose, amounting to approximately £1,500,000. This the directors regarded as a triumph crowning the long years of effort by the company. The example set by this country had influenced the decisions of telephone administrations throughout the world. The conversion of London from manual to automatic working was probably the largest and most important work that had ever been undertaken in the telephone world. It was a task which would keep that company, and the other manufacturers concerned, busy for some years to come. The problem of London was unique, inasmuch as the whole of its complicated network of telephone connections had to be changed from manual to automatic while maintaining existing services and catering for current expansion. The very large amounts the company had spent in building up a technical and engineering organisation of the first order had been entirely justified. The company purchased all its materials in this country and its products were British throughout. In addition to the London contract the directors had secured a large number of orders from the Post Office for Cardiff, York, Shrewsbury, Torquay, Maidenhead, Weston-super-Mare, Gloucester, &c., and through their associated company, the International Automatic Telephone Co., Ltd., they had been actively engaged in constructions abroad. For the Bombay Telephone Co. 11,000 lines had been completed, and that exchange was successfully brought into service on the 17th ultimo. Further foreign work had been for the Manchurian Government and for the Buenos Ayres installation of the United River Plate Telephone Co., and other orders for Argentina totalling over 13,000 lines. Arising out of the terrible catastrophe in Japan, a very large order—about 30,000 lines—had been received by the company in conjunction with the Western Electric Co., Ltd., for the supply of automatic apparatus for Tokyo. This would be upon the Strowger system. In Sydney an order for 12,000 lines had been secured. The business was acquiring a very substantial impetus all over the world.

Profits were largely determined by home fluctuations in labour and material costs, and there were indications throughout the country of a demand for increased wages. He had no objection to seeing wages higher, but they must be accompanied by increased individual production. Expenditure on telephonic development provided for employment for an increasing number of people, moreover, the expenditure was revenue producing, and the development of the telephone was a direct aid to the business life of the country.

It is announced that the £210,000 6½ per cent. first mortgage bonds, forming the total amount issued by the company to the public, has been acquired by British investors. The issue was made in 1921 through the company's associates in America, in connection with contracts for foreign business.

International Automatic Telephone Co., Ltd.

Sir Alex. Roger presided at the annual meeting, held at Liverpool on June 5th. He referred to the improvement in the accounts as compared with those of previous years. Although the company's progress had not been rapid, each year had shown an increase of profit. The increase for 1923 was largely due to the 3 per cent. dividend on the ordinary shares of the Automatic Telephone Manufacturing Co., Ltd., nearly 70 per cent. of which were held by the International Co. The speaker remarked that the observations made at the meeting of that company were equally applicable to the affairs of the International Co.

Madras Electric Supply Corporation, Ltd.

Mr. James Gray, in his speech at the annual meeting held on June 4th, said that the very large proportion of the increase of 19.38 per cent. in units sold was due to increased power demand. The sales for that purpose were now nearly 50 per cent. greater than for lighting and fans. There was great scope for development in this direction, including the further development of native industries in Madras. The total revenue had increased by 14.9 per cent., but there was a serious increase in the cost of coal, and there was no prospect of any reduction this year. Mr. Jones, the chief engineer, who was home on leave, was investigating the practicability of adapting the boilers for oil fuel. They had placed a contract for a large quantity of Singareni slack and coal for 1925, which would effect a very considerable saving next year. After referring to the accounts and to the tramway operations, the chairman said that, in regard to local management, they had decided that the time had arrived when the affairs of the company in Madras might be managed entirely by their own staff, and they had therefore terminated the arrangement with Messrs. Binny & Co.

United Electric Tramways of Montevideo, Ltd.

The report for the year ended March 31st, 1924, says that the operation of the tramway system for the year to October 31st, 1923 (the fiscal year of the Uruguayan Company), shows gross receipts at an exchange of $4.7 to the £ of £634,07[illegible], being an increase of £66,949. Operating expenses, however, increased by £45,529, mainly due to higher wages and taxation, as well as to a natural increase in all expenditure arising from increased traffics. Remittances continued to be seriously affected by the low rate of exchange which prevailed during the whole year, and the loss on exchange for the year amounted to £30,957. Passengers carried, 76,359,446; increase 7,667,484. Car miles run, 10,039,929; increase 979,200. Orders have been placed recently for 30 additional motor tramcars; 25 trailers are being built in the shops at Montevideo. The question of an increase in tariffs remains in abeyance. The long delay in authorising a readjustment of fares, which should have accompanied the onerous burdens placed on the company by social laws, prejudices the company, its staff, and the interests of the travelling public. Notwithstanding this arbitrary treatment, the company has continued to fulfil all the obligations of its concessions. The extent to which it has been deprived of the prosperity which would enable it to further improve and develop its services, is illustrated by the fact that, over a period of nine years, the company has been able to pay only one dividend of 4 per cent. to its ordinary

shareholders. The profit and loss account, after providing for administration expenses, and charging £45,543 for debenture interest, shows a credit balance of £45,736, plus £1,327 brought forward. £6,957 is set aside for redemption of debenture stock; £2,500 for redemption of preference and ordinary shares; and £10,000 for renewals and contingencies. After paying the preference dividend, 6 per cent., less income tax, £4,357 is carried forward.

French Companies.

The *Compagnie des Locations Electriques*, of Paris, reports net profits of 222,000 fr. for 1923 and a dividend at the rate of 5 fr. per share.

The *Compagnie Parisienne de Distribution d'Electricité* earned net profits of 27,860,000 fr. in 1923, or 3,463,000 fr. more than in the previous year. It is intended to pay a dividend at the rate of 50 fr. per share as against 40 fr. in 1922.

The *Compagnie l'Appareillage Electro-Industriel* (Petrier Tissot and Raybaud), of Lyons, which is specially occupied with the production of circuit-breaking devices, reports net profits of 535,000 fr. for 1923, and a dividend at the rate of 70 fr. per share. The turnover increased last year by 40 per cent. over that in 1922, and further branches are to be opened to extend the business.

Italian Companies.

Società Adriatica di Elettricità (Venice).—The year's working to December 31st last showed a net profit of 11,152,063 lire, from which a dividend of 10 lire per share was distributed.

Società Anonima Elettricità Alta Italia (Turin).—The improvement and extension of the transmission plant enabled this company to distribute 70,000,000 kWh more than in the preceding year. The profit was 9,324,811 lire, allowing of the distribution of 20 lire per 250-lire share.

Società Emiliana di Esercizi Elettrici (Parma).—The capital is being increased from 28,000,000 to 42,000,000 lire by the issue of 400,000 new 35-lire shares.

Anglo-Portuguese Telephone Co., Ltd.—The report for 1923 states that the capital expenditure for the year 1923 amounted to £40,204, against £48,492 for 1922, and the gross profit to £2,710, against a loss of £6,607 for 1922. After payment of income-tax, £1,146, and providing for debenture interest and sinking fund, £8,765, the total loss for the year is £7,200, against £16,201 for 1922. The balance of £13,461 at debit of profit and loss has been charged against reserve, which is reduced to £1,608. The year's revenue receipts and expenses have been converted into sterling at an average of 2 33/128d. per escudo.—*Financial News.*

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Venezuela Telephone and Electrical Appliances Co.—70,000 8 per cent. cumulative participating preference shares of £1 each, fully paid, Nos. 70,001 to 140,000.

Application has been made to the Committee to allow the following to be officially quoted:—

Cawnpore Electric Supply Corporation.—78,507 7 per cent. cumulative preference shares of £1 each, fully paid, Nos. 120,001 to 198,507.

Lancashire Electric Light and Power Co.—628,560 ordinary shares of £1 each, fully paid, Nos. 1 to 628,560.

Oriental Telephone and Electric Co., Ltd.—After paying the preference dividends, a final dividend of 6 per cent. on the old ordinary shares is to be paid, making 10 per cent., tax free, for the year, and a final dividend at the rate of 10 per cent. per annum (free of tax) is to be paid on the new ordinary shares.

Ruston & Hornsby, Ltd.—No dividend on the ordinary shares for the third year in succession. The arrears on the five and six per cent. preference shares are to be paid for the eighteen months ended December, 1922. Though the year's trading showed signs of improvement, adverse world conditions restricted the volume of business.

A Swiss Company.—The Alioth Electricity Company of Basle, which stands in a community of interests with Brown, Boveri & Company, realised net profits of 347,000 fr. in 1923 as compared with 342,000 fr. in the preceding year, and the dividend at 6 per cent. is the same rate as in 1922.

Richardsons, Westgarth & Co., Ltd.—The directors report 1923 as a year of intense depression. The distribution on the ordinary shares is at the rate of 10 per cent., as compared with 18 per cent. in the previous year. The profit was £179,133, as compared with £329,547 in 1922.

Calcutta Electric Supply Corporation, Ltd.—The units sold during the three months ended March 31st were 16,799,543, as against 13,358,526 for the corresponding period of 1923, an increase of 3,441,017.

Pinchin, Johnson & Co., Ltd.—Dividend at the rate of 6¼ per cent. per annum, less tax, on the preference shares for the six months to June 30th.

Manila Electric Corporation.—Dividend declared of 2 per cent. for the quarter ended June 30th on common capital stock.

Cape Electric Tramways, Ltd.—Interim dividend of 3 per cent., free of tax.

Kidderminster and District Electric Lighting and Traction Co., Ltd.—After paying a dividend of 2½ per cent. on the ordinary shares, and putting £1,500 to reserve, £655 is to be carried forward.

Simms Motor Units (1920), Ltd.—Dividend for 1923, 5 per cent. £4,941 carried forward.

Stocks and Shares.

TUESDAY MORNING.

HOLIDAY influences have been at work to lay a restraint upon business in the Stock Exchange markets, and the manner in which the Tube strike developed at the end of last week had the effect of a damp sponge passed over even the moderate bullishness which existed previously. It was a little curious that prices in the Underground Railway group should have suffered comparatively little, for Districts are no more than 10s. down and Metropolitans are unchanged. Underground Electric bonds went back to 94, but the £10 shares at 51s. 3d. are nominally 1/16 higher. The rest of the railway list showed a tendency to give way, though there has been no particular pressure to sell stock.

One of the leading economists of the day is pleading for the expenditure of very much larger sums of public money in this country than have been laid out during the past six months. Mr. J. M. Keynes declares that we have spent no more than ten million pounds sterling upon home industries within a period of six months that has seen huge quantities of capital go abroad in exchange for investments yielding quite modest returns on the money. The Government is understood to be on the point of raising a considerable sum, either through the medium of Local Loans or some new issue, to provide financial facilities for the housing scheme, but under the Trade Facilities Act, powers are available for granting further large sums to the railway companies which require money for electrification programmes.

Cable stocks are still heavy and Eastern ordinary can be obtained at 166, and Eastern Extensions at 16¼. The rest of the group, although unchanged in nominal quotations, leans to the dull side. Cabling the result of the Derby to various parts of the world enabled the Eastern Telegraph Company to establish a fresh record for speed, the news being in Australia one minute after it had left London. The wireless market is also dull, in spite of the new and remarkable developments reported in connection with telephoning to the Antipodes.

The Chile Telephone Company has obtained its new concession for a term of twenty years, and the price of the shares is a little harder at 6 bid, now that the slight nervousness felt in regard to this concession has been removed. Venezuela Telephones are better at 14s. 6d. Automatic Telephone shares have risen 4s. during the past few business days, and stand now at 24s., last Thursday's meeting at Liverpool having been of a very satisfactory character. International Telephone shares advanced in sympathy to 19s. 3d., and, in market parlance, both shares are talked better. United River Plates shed ¼, although the report is excellent, the profit of £214,000 being £23,500 up.

Electricity supply shares show curiously few changes. In the London group, St. James' rose 5s. to 13¾ and South Londons 1/16 to 43s. 3d. Kensingtons, on the other hand, dropped back to 9½. Whitehall preference further improved to 22s., and the debenture stock is good at 97, there being extremely vague rumours afloat that the latter stock is either to be repaid at par at some early date, or replaced by another form of security. In Midland Counties Electric there is a fair amount of trade passing. The ordinary and 6 per cent. preference stand at 20s.; the 5 per cent. debenture is quoted at 96¼.

Metropolitan-Vickers ordinary receded to 1 1/16; Brush ordinary remain at 22s., and the tendency of electrical manufacturing shares is inclined to be a little easier after the rises which occurred last week. General Electrics, exceptionally, hardened to 20s. 9d. Electric Constructions are unaffected by the company's report to the end of March last. The profits are given as £40,300, a reduction of £10,000 as compared with the previous year, and going against £82,600 for the twelve months 1921-22. The dividend on the ordinary shares is maintained at 10 per cent. Evidently the board considers that the outlook justifies a courageous course being taken in the distribution of the profits. Nothing is put to reserve this time, though a staff superannuation fund receives £5,000, and about £22,000 is carried forward.

London Tramway and Traction issues are in no way disturbed by the Tube strike and its possibilities of extension. British Electric Traction preference has put on a point. Mexican Utilities are heavy, the country's Government bonds being flat on the latest-of-all disappointment at the failure of order to replace a ten years' unsettlement. Brazilians have been disposed to droop by reason of the dwindling of the milreis. On the other hand, the movements in New York exchange are helping prices of the bonds and shares upon which the dividends are paid in dollars.

Babcock & Wilcox go steadily ahead, being now up to 2¾, at which price the yield on the money is little more than 5 per cent., tax free. Victoria Falls ordinary are again better at 36s., although the reason for the rapid rise in the price of the shares is still a matter of speculation. A sudden revival of interest and strength in Kaffir shares is, of course, an assistance to the holders of Victoria Falls. The engineering and allied lists move within narrow and irregular limits. Rubber shares are a little better in places, but the price of the raw material remains below 1s. per lb., and so affords neither stimulus to prospective purchasers nor encouragement to present shareholders.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom. £	Dividend. 1922.	Dividend. 1923.	Price June 6, 1924.	Rise or fall.	Yield. p.c.
Brompton Ordinary	1	12	10	37/-	—	*£5 8 1
Charing Cross Ordinary	1	14	14½	42/-	+6d.	6 18 2
do. do. do. 4½ Pref.	1	4½	4½	17/-	—	5 6 0
Chelsea	1	10	12	36/3	—	6 13 7
City of London	1	15	15	45/9	—	6 11 0
do. do. 6 % Pref. ...	1	6	6	23/6	—	5 2 2
County of London	1	10	15	47/-	—	6 7 8
do. do. 6 % Pref. ...	1	6	6	1⅛	—	5 6 8
Edmundson's Ordinary	3	7	7	5	—	4 4 1
do. 6 % Pref.	5	6	6	5⅛	—	5 17 1
Kensington Ordinary	5	12	14	9¾	— ¼	7 3 7
London Electric	1	10	10	30/-	—6d.	6 11 2
do. do. 6 % Pref. ...	5	6	6	5⅜	—	5 11 7
Metropolitan	1	8½	10	1⅞	—	5 14 3
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	2½	6	18/9	—	6 8 1
do. 5 % Pref. ...	1	5	5	17/-	—	5 17 8
do. 7 % Pref. ...	1	7	7	24/-	—	5 16 8
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	21/3	—	5 13 0
Urban Ordinary	1	—	4	18/9	—	4 5 8
do 6 % Pref. ...	1	5	6	1	—	6 0 0
St. James' and Pall Mall ...	5	14½	17½	13⅜	+ ½	6 10 10
South London	1	11	15	43/3	+ 1/16	6 18 7
South Metropolitan Pref. ...	1	7	7	1¼	—	5 12 0
Westminster Ordinary	5	12	15	10½	—	7 6 4
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	22/-	+6d.	6 16 6

HOME RAILS.

Central London Ord. Assented Stock	4	4	68½	—	5 16 10
Metropolitan ... ... ,,	3½	4	80½	—	4 19 5
do. District ... ... ,,	3	3½	51½	— ½	6 16 0
Underground Electric Ordinary	10	Nil	Nil	2 1/16	+ 1/16	Nil
do. do. "A" ...	1	Nil	Nil	7/6	—6d.	Nil
do. do. Income Bonds	5	6	9¼	—	*6 7 8

TELEGRAPHS AND TELEPHONES.

		Dividend. 1921	Dividend. 1922			
Anglo-Am. Tel. Pref. ... ... Stock	6	6	103½	—	5 16 0
do. Def. ... ... ,,	1½	34/6	23/6	+ ⅛	6 5 8
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	7	—	10 0 0
Eastern Extension...	10	10	10	16½	— ⅛	6 1 3
Eastern Tel. Ord.	Stock	10	10	168½	—1	6 0 1
Globe Tel. and T. Ord.	10	10	10	17½	—	5 14 3
do. do. Pref.	10	6	6	11⅛	—	5 7 10
Great Northern Tel.	10	24	22	28½	—	7 14 4
Indo-European	25	10	7	83½	—	*5 6 1
Marconi	1	25	15	1½	—	10 0 0
Oriental Telephone Ord.... ...	1	12	12	1⅛	—	*6 8 9
United R. Plate Tel.	5	8	8	6⅝	— ⅛	*5 16 6
West India & Panama	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	16½	—	6 1 3

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	12½	8⅛	—	8 9 0
do. do. 2nd Pref. ...	5	Nil	5½	2⅛	—	10 4 4
do. do. 5% Deb. ...	Stock	5	5	71½	—	6 19 10
British Electric Traction Ord. ...	,,	4½	5	85	—	7 1 2
do. do. 6% Pref. ...	,,	6	6	102½	+1	5 17 3
Brazil Traction	100	Nil	4	57	—	7 0 0
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	80½	—	5 15 7
do. do. Preferred	,,	5	90/-	87½	—	*5 10 9
do. do. Deferred	,,	8	127/-	103½	— ½	*6 5 0
do. do. Deb.	,,	4½	4½	81½	+1	5 4 4
Lond. & Sub. Trac. 5 % Pref. ...	1	8½	5	7 6	—	6 13 4
London United Tram. Deb. ...	Stock	4	4	47	—	8 10 2
Mexico Trams. 5% Bonds ...	—	Nil	Nil	73½	—1	6 18 0
do 6% Bonds ...	—	Nil	Nil	60½	—	Nil
Mexican Light Common ...	100	Nil	Nil	23½	—	Nil
do. Pref.	100	Nil	Nil	47½	—	Nil
do. 1st Bonds ...	—	Nil	5	67½	—1	7 6 6

MANUFACTURING COMPANIES.

Babcock & Wilcox...	1	15	20	47/6	+6d.	*5 1 2
British Aluminium Ord.... ...	1	10	5	24/6	—	4 1 8
British Insulated Ord.	1	15	15	2⅝	—	5 14 3
Callenders	1	15	15	2 1/16	+ 1/16	5 11 6
do. 6½ Pref....	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	10	5	⅝	—	8 17 10
Edison-Swan	4/-	Nil	⅛	5/-	—	6 0 0
do. ,, 5% Deb.	Stock	5	5	78½	—	6 7 5
Electric Construction	1	10	10	1⅞	—	6 7 5
English Electric	1	8	5	16/9	—	5 19 5
do. do. Pref.	1	6	6	19/6	—	6 3 1
Gen. Elec. Pref.	1	6½	6½	23/6	—	5 10 8
do. Ord.	1	10	5	20/9	+ 6d.	4 16 5
Henley	1	15	15	2⅝	—	5 14 3
do. 4½ Pref.	5	4½	4½	4½	—	5 9 1
India-Rubber	1	10	10	½	—	*7 5 6
Met.-Vickers Pref....	2	8	8	2⅞	—	6 11 2
Siemens Ord.	1	10	10	18/3	—	Nil
Telegraph Con.	12	20	20	24	—	*5 0 0

* Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.	Price June 10.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	5½d.	...
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£25	...
a Copper Sulphate ... ... ,,	£25 10s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	4½d.	...
a Shellac ... ... per cwt.	£15 15s.	...
a Sulphur, Sublimed Flowers ... ,,	£7 15s.	...
a ,, Roll ... ... ,,	£7 15s.	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£125 to £130	...
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		...
Grade I ... ... per ton net	£205	£8 dec.
Grade II ... ... ,, ,,	£148	£4 dec.
Grade III ... ... ,, ,,	£85	...
c Brass (rolled metal 2" to 12" basis) per lb.	9¾d.	...
c ,, Tubes (solid drawn) ... ,,	1/- to 1/0½d.	...
c ,, Wire, basis ... ... ,,	9¼d.	...
c Copper Tubes (solid drawn) ... ,,	1/1½d.	...
c ,, Bars (best selected) ... per ton	£94	...
c ,, Sheet ... ... ,,	£94	...
c ,, Rod ... ... ,,	£94	...
d ,, (Electrolytic) Bars ... ,,	£88	£1 inc.
d ,, ,, Sheets ... ,,	£143 10s.	...
d ,, ,, Wire Rods ,,	£78	£1 inc.
d ,, ,, H.C. Wire per lb.	10d.	½d. inc.
f Ebonite Rod ... ... ,,	2/- to 3/6	...
f Sheet ... ... ,,	2/- to 3/6	...
a German Silver Wire ... ... ,,	2/3	...
h Gutta-percha, fine ... ... ,,	nom.	...
h India-rubber, Para fine ... ... ,,	11½d.	...
Iron Pig (Cleveland Warrants) ... per ton.	£5 2s. to £5 2s. 6d.	...
j ,, Wire, galv. No. 8, P.O. qual. ,,	£25	...
g Lead, English Pig ... ... ,,	£34	£9 inc.
g Mercury ... ... per bot.	£13 5s. to £13 10s.	...
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/3½	...
p ,, ,, drawn bars & rods ,,	1/8½	...
p ,, ,, rolled strip & sheet ,,	1/3½	...
p ,, ,, wire ... ... ,,	1/3½	...
o Platinum ... ... per oz.	£26	...
d Silicium Bronze Wire ... ... per lb.	1/6½	...
r Steel, Magnet, in bars ... ... ,,	8d.	...
n Tin, Block (English) ... ... per ton.	£218 10s. to £219	£8 to £9 inc.
n ,, Wire, Nos. 1 to 16 ... ... per lb.	3/8	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
j Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Engineering Wages Conference.—According to Press reports a private conference was held on June 5th, at the Great Central Hotel, Marylebone, between the Engineering Employers' Federation and a number of engineering unions, including the Amalgamated Engineering Union, to discuss the demand for an advance of £1 per week on the present rates in the industry. The conference was the outcome of two meetings held recently between the employers and the unions to consider, on the invitation of the employers, how the present unsettled conditions in the industry might be ended and stability secured. The unions then declined to discuss stabilisation of the industry until their wage demand had been dealt with. *The Times* reports that after the meeting Mr. J. T. Brownlie, secretary of the A.E.U., said that he and Mr. Chadwick, on behalf of the men, stated their case for an advance of 20s. a week, with corresponding increases in the rates for piecework. There were over 20 organisations connected with the engineering and allied trades represented. Sir Allan Smith, he added, promised on behalf of the employers that their statements should receive earnest consideration, and a report would be made to the local employers' organisations for their comments thereon. The conference adjourned until July 2nd, when the employers hope to be in a position to give a definite answer to the application.

Civil Service Commission.—Male Assistant Superintendent of Traffic (Class II) in the London Telephone Service and Assistant Traffic Superintendent in the Provinces.—July 10th is the latest date for applications in connection with the forthcoming competition. (See our advertisement page to-day.)

Power Transmission Lines.—II.

Aspects of their Design.

By WILLIAM T. TAYLOR, M.Inst.C.E., M.I.E.E., Fel. A.I.E.E.

(Concluded from page 909.)

TAKING one example of the advantage of the long span and the use of copper over *all*-aluminium, to carry the latter conductor on 400-ft. spans means for, say, 0·1 sq. in. copper equivalent 50 per cent. extra windage and nearly 50 per cent. extra sag, and the line supports must be about 6 ft. higher and about 50 per cent. stronger laterally; thus, any saving in the cost of conductors may become a loss in the added cost for line supports, &c. The steel-aluminium conductor can be given much less sag and much longer spans, because of its greater tensile strength; this has many advantages over the all-aluminium conductor, and its use may also mean a great saving in rents, &c., for wayleaves. The actual normal sags for steel-aluminium are very much smaller than the corresponding sags for copper conductors of equivalent conductivity, and it will permit the use of shorter line supports or longer spans than can be used with the copper conductor; it also has the property of steel (steel-core cable), so far as sag is concerned, and substantially the property of aluminium (in a.c. circuits) so far as aluminium (outer strands) is concerned.

In the design of overhead electric power lines both the size and the spacing of the conductors are first determined; the line-voltage, voltage regulation and other factors tending to place a limit on both, *i.e.*, on the size and spacing of the conductors. The line-voltage is governed by several economic as well as technical considerations; the former have purposely been omitted from this article. Line-voltage should increase with the distance of transmission, and as the kVA capacity is increased, and also as the cost of energy increases. The following *empiric* formula is suggested as a trial determination for line-voltage at the receiving end.

$$E_r = (k + 0{\cdot}00001\ P')\ l \text{ kilovolts} \qquad (10)$$

where E_r = voltage between lines at the receiving end.
l = distance of transmission line in miles of single conductor.
P' = kVA transmitted over the line to receiving end.
k = *coefficient* (see Table II).

For the *most economical* transmission line-voltage (voltage between lines), an empirical formula may take the form:—

$$E = k' (P'l)^x$$

where P' = kVA transmitted over the line.
l = transmission distance in miles.
k' = coefficient of cost of energy per kW year.
x = coefficient.

TABLE II.

(l) Distance in miles.	(k) Coefficient.	(l) Distance in miles.	(k) Coefficient.
25	1·070	30	1·0340
20	1·126	40	0·9750
15	1·175	45	0·9645
13	1·200	50	0·9275
10	1·275	55	0·9240
6·5	1·375	60	0·9090
5	1·464	65	0·8990

Example: For a three-phase aerial power line, 30 miles length per line-conductor, delivering 2,450 kW at 85 per cent. power-factor, we have, as a first trial determination of line-voltage *at the receiving end*:—

$$E_r = (1{\cdot}034 + 0{\cdot}00001 \times 2{,}450/0{\cdot}85) \times 30$$
$$= (1{\cdot}034 + 0{\cdot}02882) \times 30$$
$$= 1{\cdot}0628 \times 30 = 31{\cdot}9 \text{ kV};$$

the standard receiving voltage recommended is 30,000 volts.

In practice only standard commercial voltages E_g and E_r are dealt with and actually considered in line calculations. Also, in general, conditions for calculations are based on the receiving-end voltage (E_r), and the load power-factor ($\cos\phi$) is invariably assumed as ranging between 80 and 90% —generally 85%. For these conditions, and to save labour in the use of the formula: $I = (kW \times 1{,}000) \div (\sqrt{3}\ E_r \cos\phi)$, the following table should be helpful to those requiring (without calculation) the values of line current I (per line conductor) for three-phase systems:—

TABLE III.

(E_r) *Standard* Receiving-end Voltages.	$I = P/(\sqrt{3}\ E_r \cos\phi) = 0{\cdot}578\ [(P/(E_r \cos\phi)]$ in amperes per 100 kW delivered at different power-factors.							
	·80	·82	·84	·85	·86	·88	·90	·92
6,000	12·01	11·78	11·45	11·31	11·19	10·93	10·69	10·47
10,000	7·217	7·040	6·870	6·792	6·716	6·560	6·415	6·280
15,000	4·812	4·692	4·580	4·528	4·478	4·372	4·276	4·186
20,000	3·609	3·520	3·440	3·396	3·360	3·280	3·210	3·140
30,000	2·408	2·346	2·290	2·264	2·239	2·186	2·108	2·093
40,000	1·805	1·760	1·718	1·698	1·678	1·640	1·604	1·570
50,000	1·443	1·408	1·374	1·358	1·343	1·312	1·283	1·256
60,000	1·203	1·173	1·145	1·132	1·119	1·093	1·069	1·047

This table can be used for other voltages and for any kW value; it can also be used for single-phase lines. Thus, 1,000 kW at 60,000 volts and 80% power-factor, the current I is 12·03 amps. per conductor; for 100 kW at 6,000 volts and 80% power-factor the current is 12·03 amps., and for 10 kW at 600 V and 80% power-factor the current is 12·03 amps. per conductor. Also, find the current in a three-phase line delivering 2,450 kW at 85% power-factor with receiving voltage of 20,000 volts. In this case we find:—

I = 3·4 amps. per 100 kW; then, for 2,450 kW the current per conductor is 3·4 × 24·5 = 83·3 amperes.

For amperes per conductor per 100 kW of a (2-wire) single-phase system, multiply table values by 1·732. Thus, for a three-phase (3-wire) 20,000-volt line and 80% power-factor, we have 3·61 amps. per conductor; for a single-phase (2-wire) line at the same voltage, power and power-factor, we have 3·61 × 1·732 = 6·25 amps. per conductor.

In finding the line resistance-volts (IR cos ϕ) usually very little time is spent, but it is quite a different matter when we have to determine the line reactance-volts from formula (IX sin ϕ), which requires a table of logarithms. There are, of course, certain short-cut methods which one might apply; for instance, on careful study of Chart II it will be evident that the value of self-inductance L, or the inductive reactance X for a given frequency, is fixed for a constant value of the ratio s/d, and that, for a given percentage difference in the value of s there is a constant value of self-inductance, or reactance for a given frequency, regardless of the value of the conductor diameter d. As regards the ohmic resistance values, to find the value of R for any given size of conductor simply follow the vertical line for given size of conductor until it intersects the oblique line corresponding to the given class of conductor (solid, stranded, copper, all-aluminium, &c.) when to the right we obtain directly the value R in ohms or IR in resistance-volts per amp. Inversely, we may also find the size of conductor when the power loss or the ohmic resistance has been assumed. This part of Chart II can be used for:

(*a*) Obtaining the size of conductor when the power loss is given (see the following example).
(*b*) Obtaining directly the voltage drop per amp. in d.c. lines.
(*c*) Obtaining the ohmic resistance for standard commercial sizes of conductors (copper, all-aluminium and steel-aluminium).

Example: A three-phase (3-wire) transmission line requires exactly 90 miles of conductor (30 miles of single line-conductor); the estimated three-phase load is 3,000 kW at 80% power-factor; the delivered voltage is 30,000 volts between line-wires; the size of conductor decided upon is No. 1/0 L.S.G. hard drawn copper wire. *Determine the power loss.*

Referring to Chart II, the ohmic resistance per mile of No. 1/0 wire at 25° C. is seen to be 0·55 ohm, making R = 0·55 × 30 = 16·5 ohms. From table of current values I

per 100 kW, we have 2·406 amps. per 100 kW, and 2·406 × 80 = 72·2 amps. full load current per wire.

Power loss in the three-phase line is expressed—

$$p = 3\,\mathrm{I}^2\,\mathrm{R}\,l = 3 \times (72{\cdot}2)^2 \times {\cdot}55 \times 30 = 258 \text{ kW}. \quad (11)$$

and the percentage power loss is expressed—

$$p' = p/\mathrm{P} \times 100 = 258/3{,}000 \times 100 = 8{\cdot}6\%$$

Example 1a: Let conditions given in the above example remain the same but let us here assume a power loss of 8·6 per cent. *Determine the size of conductor.*

$$p = p'/100 \times \mathrm{P} = 8{\cdot}6/100 \times 3{,}000 = 258 \text{ kW} \quad (12)$$

is the power loss in the three-phase (3-wire) line.

The load current I = 72·2 amperes (as before); the total ohmic resistance per single conductor is expressed—

$$1/3 \times p\ 1{,}000/(\mathrm{I})^2 = 1/3 \times 258 \times 1{,}000/(72{\cdot}2)^2 = 16{\cdot}5 \text{ ohms}. \quad \ldots \quad (13)$$

Therefore, resistance per mile of single conductor is 16·5/30 = 0·55 ohm. From the Chart, size of hard drawn copper wire is seen to be No. 1/0 L.S.G.

Chart II gives ten different values for R (ohmic resistance), indicated as follows:—

(*a*) Is for hard drawn copper wire at 0° C.
(*a'*) Is for hard drawn copper cable at 0° C.
(*b*) Is for hard drawn copper wire at 50° C.
(*b'*) Is for hard drawn copper cable at 50° C.
(1) Is for hard drawn copper wire at 60° F.
(2) Is for hard drawn copper wire at 25° C.
(3) Is for hard drawn copper cable at 60° F.
(4) Is for hard drawn copper cable at 25° C.
(5) Is all-aluminium for aerial lines at 60° F.
(6) Is steel-aluminium for aerial lines at 25° C.

The Chart also gives one value of X (inductive reactance) for solid and for stranded conductor; the former conductor is given in *L.S.G. gauge* and the latter in *sq. inch sectional area* values. This value of reactance (indicated by X) is for a 50-cycle system; for any other frequency f', multiply Chart values by the corresponding frequency coefficient given at the bottom of the Chart, or use formula $X' = X\,(f'/f)$, where X' = inductive reactance for desired frequency f', f' = desired frequency, f = for 50 cycles, and X = inductive reactance for 50-cycle system.

The inductive reactance or reactance-volts part of the Chart is quite simple to follow and will no doubt be found the most valuable part of the Chart. The arrangement as presented here is a development on the slide rule; the diagonal lines represent the moving element of the slide rule.* This part of the Chart can be used for:

(*a*) Obtaining directly the inductive reactance X for any spacing of the conductors (in inch or fractional values) from 10 up to 200 inches. This is most desirable in view of the fact that regular flat or an irregular or/and unsymmetrical arrangement of the conductors of a three-phase line will most often call for an odd or fractional value or figure for the average or effective spacing, hence, the conductor separation in intervals of one inch or of fractions of an inch is desirable in practical work.

(*b*) Obtaining self-induction L simply by dividing the values given in Chart by 6·283 *f*.

(*c*) Obtaining the values of L or X or IX per amp. for standard commercial sizes of solid or stranded conductor.

(*d*) Obtaining values of inductive reactance X for any frequency by multiplying Chart values for X by respective frequency coefficients given at the bottom of the Chart.

To use the inductive reactance X part of the chart, start from the right of chart and move along the horizontal logarithmic line for given S value to the intersection of the vertical line (plotted to logarithmic scale) for size of conductor. At the point where these two values intersect, move along parallel to the diagonal lines, to a point crossing the X line, when to the left and horizontal with the meeting of the X line and the diagonal line, we obtain the required value of inductive reactance X.

As the prevailing conditions of aerial a.c. lines are for lagging power-factor ranging from 80 to 90 per cent., a simple and sufficiently accurate formula for voltage drop per mile of single conductor is expressed—

$$\mathrm{IR}\cos\phi + \mathrm{IX}\sin\phi, \quad \ldots (14)$$

and for a three-phase (3-wire) line the total voltage drop is—

$$e' = \sqrt{3}\,\mathrm{I}\,(\mathrm{R}\cos\phi + \mathrm{X}\sin\phi)\,l; \quad \ldots (15)$$

for a single-phase (2-wire) line

$$e' = 2\,\mathrm{I}\,(\mathrm{R}\cos\phi + \mathrm{X}\sin\phi)\,l \quad \ldots (16)$$

The voltage at the generating end is expressed—

$$\mathrm{E}_g = \mathrm{E}_r + e', \quad \ldots \quad \ldots (17)$$

but $$\mathrm{E}_g = \sqrt{(\mathrm{E}_r\cos\phi + \mathrm{IR})^2 + (\mathrm{E}_r\sin\phi + \mathrm{IX})^2}. \quad (18)$$

The voltage regulation is expressed—

$$e = (\mathrm{E}_g - \mathrm{E}_r)/\mathrm{E}_r \times 100, \quad \ldots (19)$$

where E_g = voltage at the generating end.
l = distance of transmission line (line-conductor) in miles of single conductor.
E_r = voltage at the receiving end of the line.
I = line current in amperes per conductor.
R = ohmic resistance per mile of single conductor.
X = inductive reactance per mile of single conductor.

Now that we have all the necessary information available, let us consider a more complete example involving all the principal factors of the complete electric circuit (neglecting the power transformers).

Example: A three-phase power transmission line, requiring approximately 75 miles of overhead line conductors (exactly 25 miles of 3-phase line), is to be constructed from a steam-electric station to a town approximately 25 miles distant. The estimated future three-phase full load is 4,000 kW, and the power-factor of the load, for designing purposes, is taken at 85 per cent. lagging; the frequency conforms with that of neighbouring systems, and is 50 cycles. Given the size of conductor as three wires consisting of No. 1/0 L.S.G. hard-drawn copper, determine the following: (*a*) line-voltage; (*b*) spacing of the line conductors; (*c*) line-current; (*d*) power loss; (*e*) voltage regulation.

From manufacturers' specifications and certain quotations received, the type of line-support decided upon is a standard (tested) steel pole of the lattice type; actually, the final choice of pole was between this type and a form "A" wood frame. The spacing of the steel lattice poles will be 400 ft., and sag-range of the three line conductors is estimated at a maximum of 7 ft. to 11 ft. for the two extreme temperature conditions of loading; that is to say, taking the ultimate or breaking strength of No. 1/0 L.S.G. hard drawn copper at 55,000 lb. per sq. in., and the vertical load-weight per lineal foot of this wire at 0·318 lb., then, for a 400-ft. span and an extreme load at 0°F. of 8·0 lb. per sq. ft. of wind pressure and ½ inch of ice radially, the extreme range of sag is 7·3 to 10·5 feet. Allowable tension or stress of conductor at *stringing* temperature is taken at 700 lb. maximum (see article to follow, treating of mechanical design). This represents the total transverse conductor load, or the *net* safe transverse strength of pole required. The allowable working stress is expected to result in a relatively low cost of complete line, *i.e.*, the most economical poles and their foundations, &c. As there are no angles in the surveyed line greater than 12°, the extra strength will be provided for by reducing the spans at these points and using stay wires; these wires will be used at tangents and at every *tenth* pole. The spacing of the stayed poles will provide for strength to withstand, in addition to the transversal and vertical loads, a longitudinal load caused by the breaking of one of the conductors on any side. It is estimated that the installation of an overhead "*earth*" wire will require a closer pole-spacing or a heavier and more costly pole, it is therefore decided to eliminate the "earth" wire and use a better insulator for the top conductor, which will not cost any more and in this particular locality will give as good or even better service than the "earth" wire.†

* This scheme (for a chart of any size, such as an Ordnance Map, arranged for carrying about in a coat-pocket) was first presented to large scale by the writer in 1918. See "Calculation of Electric Conductors," Messrs. Constable & Co., Ltd., publishers, London.

† It should be noted that if copper or reinforced aluminium conductors or copper-clad conductors be used, sleet will be built up to a considerable extent on them, but, if *steel wire* be used sleet will not generally accumulate on them. This is very important in view of the extra loading and stronger line supports required when copper conductor is used for the overhead earth wire or wires conforming with the new Regulations.

Size of Conductor.—As a first trial, this is taken as a No. 1/0 L.S.G. hard-drawn copper wire. From the chart, the ohmic resistance of this size of wire is seen to be 0·55 ohm per mile of single conductor *at 25°C.*; or $0{\cdot}55 \times 25 = 13{\cdot}75$ ohms total resistance for the line.

Line Voltage.—As a first trial, we have a receiving end voltage in terms of receiving end conditions, from formula (10) of—

$$E_r = (1{\cdot}07 + 0{\cdot}00001 \times 4{,}000/0{\cdot}85) \times 25 = 28 \text{ kV}$$

for a 4,000-kW load at cos $\phi = {\cdot}85$, and for $l = 25$ miles. Therefore, the nearest standard receiving voltage recommended is 30,000 volts.

Spacing of Line Conductors. For a sag of 6· ft., the spacing for No. 1/0 L.S.G. copper wire strung on pin type insulators, assuming a 10% voltage regulation or 33,000 volts at the generating end of the line, is from formula 9) and Table I—

$$s = 0{\cdot}001 \times 33{,}000 \times 1{\cdot}09 = 36{\cdot}0 \text{ inches},$$

and, for a 12-ft. sag of conductors—

$$s = 0{\cdot}001 \times 33{,}000 \times 1{\cdot}35 = 44{\cdot}6 \text{ inches}.$$

The mean value for 6 and 12 feet sags is seen to be 40·3 inches: however, it is decided in this case to drill all the cross-arms for a 36-inch spacing of conductors arranged in delta form with base of the equilateral triangle flat. In this case it is understood that this spacing of 36 inches slightly exceeds the minimum limit.

Line-Current.—From Table III the line-current is 2·262 amps. per 100 kW. at 85 per cent. power-factor, then, full load current is—

$$I = 2{\cdot}262 \times 40 = 90{\cdot}48 \text{ amps. per conductor.}$$

Total Power Loss.—From the Chart, R = 0·55 ohm at 25°C., and total R = 13·75 ohms; hence, total power loss is:

$$p = 3 \times (90{\cdot}48)^2 \times 13{\cdot}75 = 337{\cdot}7 \text{ kW}.$$

and the percentage power loss is—

$$p' = (337{\cdot}7 \div 4{,}000) \times 100 = 8{\cdot}44\%$$

With conductor temperature (summer temperature) of 50°C we have from Chart, R = ·6; then power loss is—

$$3 \times (90{\cdot}48)^2 \times 0{\cdot}6 \times 25 = 368{\cdot}4 \text{ kW},$$

and percentage power loss is—

$$(368{\cdot}4 \div 4{,}000) \times 100 = 9{\cdot}21\%$$

However, for a conductor temperature (winter temperature) of 0°C., we have, from Chart, R = 0·5, then—

$$p = 3 \times (90{\cdot}48)^2 \times {\cdot}5 \times 25 = 307 \text{ kW},$$

and percentage power loss is—

$$p' = (307 \div 4{,}000) \times 100 = 7{\cdot}68\%.$$

Voltage Regulation.—From Chart II, R = 0.55 ohm per mile of single conductor, and X = 0·577 ohm per mile of single conductor for 36-inch conductor-spacing. Sine of ϕ corresponding to the load power-factor, or cosine ϕ (·85), is 0·5267 (see bottom of Chart). Then, voltage drop is—

$$e' = \sqrt{3} \times 90{\cdot}48 \times ({\cdot}55 \times 85) + ({\cdot}577 \times {\cdot}5267) \times 25 = 3{,}016 \text{ volts},$$

therefore, voltage at the generating end is 30,000 + 3,016 = 33,016 volts and percentage voltage regulation is—

$$e = (33{,}016 - 30{,}000)/30{,}000 \times 100 = 10\%$$

for a conductor temperature of 25°C. For range of *summer* and *winter* temperatures (0° C. to 50° C.) the value of e will be different.

The above value of X = ·577 is obtained by following the vertical value for d = No. 1/0 L.S.G. to the intersection of s = 36. From the point of intersection of s and d follow the diagonal lines (or follow parallel to the diagonal lines) to where it meets the X line, when to the left is read ·577, the required inductive reactance for a 50-cycle system.

The London Electricity Supply Problem.

Parliamentary Proceedings.

(*Continued from p. 943.*)

On Wednesday, May 28th, Mr. J. M. DONALDSON, chief engineer to the North Metropolitan Electric Power Supply Co., said that the supply proposed to be given to Bishop's Stortford, now in the company's area, would take the mains through the parts of Essex which had been scheduled in the Bill as the most convenient route. This would also result in Harlow and Sawbridgeworth getting a supply, whereas if the only alternative and longer route along the Lea Valley were taken, these two towns would not get a supply.

Mr. TYLDESLEY JONES, K.C., for the County of London Electric Supply Co., suggested that a shorter and more profitable route for a main to Bishop's Stortford and Royston would be from Ware, at which point the company's mains now end.

Witness said the main already laid to Ware would be quite insufficient to meet the demands and, moreover, was only a 10,000-volt line, whereas the new mains would work at 30,000 volts.

Mr. TYLDESLEY JONES then objected to a power taken in the Bill to break up streets in Loughton, where the County of London Co. has power to supply.

Mr. DONALDSON said the reason for that was not to be able to supply in Loughton, but merely to continue the main from Chingford back to Brimsdown.

In a comparison between the ability of the North Metropolitan Power Co. and the County of London Co. to supply the more cheaply, Mr. Tyldesley Jones drew attention to the fact that it cost 3s. 6d. per ton to barge coal from the Thames to Brimsdown, where there was no railway siding as yet. On the question of coal consumption, witness said it was 2·4 lb. per kWh. As to condensing water, it was admitted that the available condensing water in the Lea Navigation at Brimsdown was sufficient only for 25,000 kW, and that the present capacity was 23,000 kW. If further water was wanted, cooling towers would have to be erected.

Some discussion then took place upon the promoters' costs of generation. Witness said he would rather not give the figures, because these things got into the papers, and if it were seen that the generating cost was ½d. per unit, people would begin to ask why they were charged 6d. per unit, without understanding the real position.

Counsel appealed to the Committee, and called for the company's last year's accounts, adding that applications had been made for copies of the accounts, but they had been refused. By law the company was bound to keep accounts on sale, and could be taken to the police court in default.

Witness promised to produce the accounts for Mr. Tyldesley Jones, and said that the cost of generation per unit sold last year was something under 0.5d. per unit, without capital charges and depreciation.

Under cross-examination by the Hon. Evan Charteris, for the Luton Corporation, Mr. DONALDSON said the price last year of the bulk supply taken from Luton was 0.56d. per unit. The company had an agreement with Luton for 21 years, and the energy was used for the supply of Harpenden and St. Albans. The charge was on a two-part tariff.

Re-examined, Mr. DONALDSON said that the Bill took powers to extend the Brimsdown power station, and it was the intention to add 100,000 kW of plant. Also it was the intention to have a railway siding installed at once, the railway line not being far away.

This concluded the case for the Bill, it being announced that the opposition of Major King had been settled.

Apart from the County of London Co., whose opposition was to be taken during the course of the promotion of that Bill, the only opponent was the Luton Corporation.

The Hon. EVAN CHARTERIS, K.C., for the Luton Corporation, said that the policy of that Corporation, to run its electrical undertaking on commercial lines, had resulted in energy being supplied at extremely low rates. The capital expenditure on the Corporation's electrical undertaking was £332,000, of which 11¼ per cent. had been repaid out of revenue. There was a reserve fund of £13,000 and a working balance of £23,450, and the consumption was the remarkable one of 257 units per head of population. The Corporation had applied to the Electricity Commissioners for a Special Order under the Electricity Supply Act of 1919 for powers to supply in bulk to Hitchin and other places, and the Rural and Urban District Councils were anxious that a supply should be given. The Provisional Order in Hitchin was in the hands of the Electric Supply Corporation, which took it over from the Urban District Council. That company entered into negotiations with Luton in 1920, and the negotiations were still going on. A supply of 250 kW was contemplated.

Without calling upon the opponents, the CHAIRMAN, after the Committee had deliberated for some time, said that if the Epping and Harlow districts were cut out of the Bill, if provision were made for Luton to carry mains through to Hitchin, and if the debenture issue was, in accordance with the usual practice, limited to one-half the issued capital, the preamble would be declared proved.

This was accepted by the promoters.

The Essex Power Bill.

The County of London Co.'s Bill was then taken.

Mr. TYLDESLEY JONES, K.C., for the promoters, said that the Bill proposed to confer upon the County of London Electric Supply Co. powers to supply electrical energy under the conditions which ordinarily appertained to power companies. There had been considerable opposition to the scheme as it was originally proposed, both from official and unofficial quarters. The Electricity Commissioners did not look with favour upon the proposals of the Bill as originally deposited, which applied to the whole of the county of Essex, and there were various opponents from the south and south-west end of the county. The result had been that the promoters now, instead of asking for the whole of the county of Essex, as was proposed in the Bill originally, had cut out of it a portion in the south-west area where there was a large number of local authorities owning electricity undertakings, including West Ham, East Ham, Ilford, Walthamstow, Leyton, Barking, Chingford, and other places. Another point arranged with the Electricity Commissioners was that so much of the area now remaining in the Bill as was contained in the area of the London and Home Counties district scheme of the Commissioners, should come within the jurisdiction of the Joint Electricity Authority, if that were formed, and the promoters had agreed that the Joint Electricity Authority should take over from them the powers in these areas within a period of 10 years of the passing of the Act. The terms of such a transfer were to be the capital expenditure on the works, less depreciation, but the company was to retain any trunk mains that might be laid through that area in order to supply districts beyond. It had been agreed to cut the Urban District Council of Brentwood out of the area. On these conditions it was understood that the Electricity Commissioners were prepared to withdraw their objections to the preamble of the Bill, although they would raise some points on clauses.

Speaking of the County of London Co., Mr. TYLDESLEY JONES said it was one of the largest in the London area; it owned the City Road and the Wandsworth stations, and was erecting a large station at Barking. This, under the terms of its sanction by the Electricity Commissioners in 1921, was to be handed over to the Joint Electricity Authority within five years, but under the settlement that had been arranged between the London companies and the London County Council, one of the terms was that the Barking station should be retained by the County of London Co. until 1971, when it would be handed over to the Joint Electricity Authority with the other generating stations of the London companies. Thus, in 1971, the Barking power station would be the largest and most important generating station for the supply of the London and Home Counties area. The County of London Co. had made rapid progress in the development of the Barking station, and it was anticipated that the first stage of 100,000 kW would be put into operation next autumn.

On Thursday, May 29th, Mr. TYLDESLEY JONES, K.C., continued his opening speech. As evidence of the progressive attitude of the company, Counsel recalled that having got a provisional order for some of the districts around Barking in 1913, it did not wait until after the war to give a supply, as most other undertakers did, but obtained the use of a plant in a brewery and supplied some of the area. Later, finding the erection of the Barking station hung up for various reasons, the company obtained the use of some generating plant at a margarine factory, and to-day 2,500 kW was being supplied. The local authorities and the power companies were working in complete harmony elsewhere, but unfortunately there was no experience in Essex of bulk supplies and thus there were many local authorities opposing, such as Southend, Colchester, &c., which asked to be left completely alone. All these places, however, would benefit considerably by such a scheme as this.

Dealing with the Bill in detail, Counsel said it took powers to supply distributors in bulk, and to supply for power purposes to industrial consumers. With regard to the supply for railway purposes, the Bill provided that a supply might be given by the company within its area for use outside its area for any purposes whatsoever, with the exception of East Ham, West Ham, Ilford, Leyton, and Walthamstow, because these authorities had already got protection against the use of energy supplied in this way being used for certain other purposes.

The report by the Minister of Transport was then dealt with. All the points raised on principle to the Bill as originally deposited had been met by the promoters, and several clause points raised had also been eliminated.

Coming to the petitions against the Bill, that of the Colchester Corporation was mentioned, which stated that the Bill was quite unnecessary. A similar petition had been put in by the Southend Corporation. The Essex County Council objected on clause matters; the East and West Ham Corporations objected but were only affected by the railway supply, upon which the promoters had met them. A settlement had been come to with the North Metropolitan Co., and the only other serious opponent was the Woolwich Borough Council, a very small portion of which was on the north of the river in the area of the promoters. Something like £200,000 had been taken out of the rates to make up the loss which this enterprising borough had made; it was the worst borough in London as regarded electricity supply.

Mr. C. H. MERZ said he had seldom been connected with a more enterprising company than the County Co., which was not afraid to spend money in advance of the demand. He considered this county an area which could not develop except in conjunction with a large electric power scheme such as was proposed in the Bill. He did not doubt that after the powers had been actually granted to the company and the supply was within reasonable distance of the opposing local authorities, negotiations would be willingly entered into for a supply. That had been the experience all over the country in the past.

The first stage of the ring main which the Company proposed to install would be from Barking to Witham and Southend, and the estimated cost was £100,000. Having gone carefully into it, he was quite confident that it would be a paying proposition. The ring main would be overhead for the most part, and would in the first place be laid out for 33,000 volts, with facilities for increasing that to 66,000 volts at any time. Harwich would be at the longest distance from Barking, 62 miles, and would eventually be dealt with in a similar manner. In the past the use of very high voltages was only possible on overhead lines, because underground cables for very high voltages were not obtainable. Now, however, cables were operating underground at 60,000 volts and over, so that they could be used in conjunction with extra-high-pressure overhead lines, and thus make the use of extra-high-pressure possible over large areas where a combination of overhead and underground cables had to be adopted. Voltages of this nature were now being used on the North-East Coast. Incidentally, it was interesting to know that the development in this country in this connection had aroused a great interest on the part of American electrical engineers, and English extra-high-pressure cables for use underground were actually being bought here for use in America. Mr. Merz said that schemes were under consideration for the electrification of the railway lines to Southend.

Sir HARRY RENWICK, chairman and managing director, said the present authorised capital of the company was £1,225,000 in £1 preference shares; £1,330,000 in £1 ordinary shares, and £1,500,000 debenture stock. He added that the last issue of £1,000,000 preference shares was subscribed ten times over. By the end of the year the company would have spent £2,500,000 on the works in Essex, and it was intended to spend £10,000,000 in that county.

Sir HARRY RENWICK was cross-examined by various Counsel with regard to the exclusion of such places as Southend and Colchester from the operation of the Bill, the arguments put in cross-examination being that these places were able to meet all the needs of their districts. Sir Harry refused to give any undertaking to meet these views.

(To be continued.)

Swiss Engineering in 1923.

A Slight Recovery.

Swiss economic conditions up to February last are reviewed in a report by Mr. O. A. Scott, of H.M. Legation at Berne, which has recently been issued by the Department of Overseas Trade.

In the opinion of Mr. Scott, who is secretary in charge of commercial affairs at the Legation, conditions are better than they were a year ago, the Federal posts and railways being well on the road to becoming self-supporting, while certain industries report a revival which almost amounts to prosperity.

Great hopes are centred in railway electrification, the acceleration of which is expected to help further many branches of Swiss industry and trade. The interesting question arises: How much material, if any, for the work of converting the railways, will need to be imported, and how much will be bought in the United Kingdom?

Mr. Scott says that as far as possible tenders will be accepted from Swiss firms unless it is found that home prices are unreasonably higher than those quoted by foreign concerns. It is added that out of an estimated total of 470 million fr. for accelerated electrification work to be executed between 1924 and 1928, approximately 25 per cent. will be sent out of the country for the purchase of raw materials. Switzerland will ultimately gain a greater independence of foreign coal supplies (she will also be able to achieve an economy of from 450,000 to 500,000 tons of coal per annum) while giving a railway traffic of the same intensity as in 1913.

Swiss Enterprises Abroad.

In connection with the extension of Swiss financial activities abroad the report mentions that in Germany (Württemberg) water power developments are being carried out with the help of Swiss capital, whilst the Mannheim branch of an important Swiss concern engaged in the electro-mechanical industry has been working very satisfactorily and increased its capital in 1923, the new shares being retained by the head concern in Switzerland. Swiss participation is reported in important water-power schemes, both in Austria and Hungary. In Turkey electric lighting and power schemes are receiving special attention from a Swiss trade mission, whilst important extensions of Swiss electrical enterprise in South America are also reported.

There is no likelihood that Swiss competition in engineering will take the form of manufacture on the mass-production system. On the contrary, Swiss industrial interests are convinced that the future of the machine industry lies in an increased output of goods of the highest quality. There is rather more employment in this branch than there was in 1922, but less than in the boom year of 1920. Mr. Scott states that the period of slump has been utilised in developing the commercial and technical sides of the industry. Locomotive building is feeling foreign competition keenly, and although Swiss electrification work will provide adequate employment for some time, new markets will have to be found sooner or later. The report mentions a notable invention in 1923, *viz.*, the so-called "propeller" type of low-head water turbine, which is stated to be far more efficient than all other known types. One power station (Wynau an der Aare) has already been equipped with propeller turbines. A new high-speed steam turbine specially adapted for electric generating purposes has also been brought out recently. In the transport line, Diesel-electric railcars are receiving increased attention on the part of private and State railways.

Foreign Trade.

During the first nine months of 1923 Swiss exports of machinery, &c., totalled 31,441 tons, valued at 107.3 million fr., as against 29,197 tons and 121.4 million fr. for the corresponding period of 1922. In 1923, Switzerland imported 16,724 tons of machinery, &c., worth 27.2 million fr., as against 17,855 tons and 27.3 million fr. in 1922. Germany is Switzerland's most important supplier of machinery, and sent 10,586 tons. The United Kingdom exported 748 tons to Switzerland, and imported 1,850 tons of Swiss productions. The chief British exports to Switzerland were the following: Spinning machinery, 300 tons; sewing machines, 101 tons; finished parts of sewing machines, 195 tons.

Among the main items exported from Switzerland to the United Kingdom were internal-combustion engines 390 tons, and hydraulic and wind engines and pumps 219 tons. Swiss exports of machine tools amounted to 1,748 tons, France taking 1,172 tons and the United Kingdom 69 tons. Swiss imports totalled 2,100 tons, the United Kingdom supplying 16 tons, France 114 tons, and Germany 1,825 tons.

Mr. Scott remarks that the outlook for 1924 in the machine industry is not very encouraging, and signs of real improvement are not yet visible.

Water-power Development.

The report summarises Swiss progress in water-power development as follows:—

The first stage in the extension of the Wynau power station on the River Aare has now been completed. Two groups of turbines have been added, which bring the total available power to 10,400 h.p. This station is to be equipped for another 4,000 h.p. Two generating sets have been erected in the Barberine power works (Canton Valais) belonging to the Federal railways. One has already undergone trials, and is now ready for service. This station is to be equipped with five sets totalling 68,000 h.p. The Barberine works, together with the Vernayaz power station (Canton Valais), the construction of which will be begun shortly, will have a combined capacity of 170,000 h.p. A huge storage lake at a height of 6,000 ft. above sea level and containing 40,000,000 tons of water held by a dam 900 ft. long will supply the necessary power.

Work on the Waeggithal (140,000 h.p.) and Chancy-Pougny (43,000 h.p.) power stations is progressing satisfactorily. The latter is expected to be completed in 1924. As a result of the financial difficulties experienced by the Grisons Power Company, the construction of the Davos-Klosters works was suspended in November, 1923. The first stage (20,000 h.p.) should have been completed in the autumn of 1924. Work was begun in 1923 on the construction of the Illsee-Tourtemagne station (23,000 h.p.).

The Lungern power works (18,000 h.p.) is to be extended shortly to 32,000 h.p. As soon as economic conditions improve, the Bernese power company proposes to build a three-stage station in the Oberhaslital (Bernese Oberland) which will supply 213,000 h.p. A project for the utilisation of the River Albigna in the Canton Grisons has been submitted for the approval of the Cantonal authorities. A storage lake for 10¼ million tons of water would supply the necessary power to a 30,000 h.p. station.

Export of Power.

The Swiss electricity supply companies have recently had surplus power available for export purposes, and have upset local consumers by quoting reduced prices to foreigners. The Federal authorities have therefore intervened and recommended the supply companies, instead of undercutting one another, to agree upon a common export price which, if possible, should be higher and in no case lower than the rates charged for local consumption. Otherwise export licences will be refused.

The question of the interconnection of all Swiss power stations is being closely examined by the authorities.

Railway Electrification.

The report gives a short survey of the progress of railway electrification. The only section of the Federal railways opened to electric traction in 1923 was the Lucerne-Zug-Zurich line, which is 55 km. long. The opening of this line brought the total length of the electrified sections to 412 km.

The Sion-Lausanne section (92 km.), which was to have been completed in the autumn, was not ready by the end of December, as a result of difficulties experienced in obtaining part of the overhead equipment. Trials were, however, carried out between Martigny and St. Maurice in December, 1923. It has now been proposed to operate the equipped section Sion-St. Maurice (46 km.) provisionally, pending the completion of the entire section which was anticipated for the spring of this year. The section Lucerne-Olten (56 km.) is practically ready, and was to be opened to electric traction before the end of January, 1924. Electrification work on the Olten-Basle division (40 km.) was well advanced, and it was expected that this section would be completed by the middle of May. The electrical equipment of the following lines has now been taken in hand:—Lausanne-Daillens-Vallorbe (47 km.), Daillens-Yverdon (19 km.), Zurich-Olten (63 km.), Olten-Berne (67 km.), Thalwil-Richterswil (15 km.), and Zurich-Rapperswil (36 km.).

These lines will be put into service in 1924-1925. In 1924 electrification work will be undertaken on the Geneva-Lausanne-Palézieux section (75 km.), as well as on the Zurich-Kloten-Winterthur division (41 km.), both of which will be ready by 1926. By the end of 1928, 1,529 km. of lines belonging to the Federal railways will be operated by electricity as a result of the adoption of a programme of "accelerated" electrification. In the plans worked out in 1918, the completion of this first stage was only foreseen for 1933.

The only electrified section of private railway put into service in 1923 was the Berne-Buempliz-Nord line (5 km.), belonging to the Berne-Neuchâtel Railway. It is also proposed to electrify the Buempliz-Nord-Chiètres section (23 km.) of that railway. The Bodensee-Toggenburg Railway (Romanshorn-St. Gall-Wattwil) is considering the advisability of equipping its system (53 km.) for electric traction.

Telegraphs and Telephones.

The report records the installation at Geneva by a British company of automatic telephone exchanges, which it is proposed also to set up at Basle in order to supplement the existing ordinary exchange. A sum of 2½ million fr. will be expended this year in connection with the displacement of a number of telegraph and telephone lines exposed to the inductive effects of the high-pressure overhead equipment of the railways.

The rivalry of telegraphs and telephones is being settled in Switzerland in favour of the latter, the Federal Department being of the opinion that the telegraphic traffic should be restricted in favour of the telephone service. Accordingly certain telegraph lines are being closed whilst long-distance telephone communications are being increased.

The manufacture of radio apparatus has been taken up by a certain number of firms already, the most important being the "Société Télévox" of Neuchâtel, the "Société Radio-Maxim" of Aarau, Zellweger & Cie, at Uster, Favarger and Cie, at Neuchâtel, the "Société Utilitas," at Lausanne, and "La Radio-Electrique, S.A.," at Geneva. A few leading foreign manufacturers, especially French firms, are represented in Switzerland.

A Large Electrically-illuminated Sign.—The British Thomson-Houston Co., Ltd., has recently completed the illumination, by means of electric flood lights, of what is believed to be the largest sign in the world so illuminated. This is at the Loughborough works of Messrs. Herbert Morris & Co. It is 512 ft. long and 40 ft. high, and consists of lettering painted upon the side of a corrugated iron building. Owing to the corrugated surface, it was not possible to use beams at right angles with the face of the building. The installation of projectors is accordingly arranged in two parts. One battery is arranged at the left, so that the beams strike the sign at an angle of 60 deg., and the other is so placed as to project its beams from the right of the sign. On this account the distance between the two end projectors is no less than 728 ft. The projectors are watertight and are equipped with one 500-kW "Mazda" gasfilled lamp each and parabolic mirrors. They are arranged on tripods in an open field in a single line parallel to and 224 ft. away from the side of the building. As showing the economy of this form of sign illumination, it may be mentioned that many thousands of lamps would be required for the "self-illumination" of a sign of these dimensions.

The Empire Mining and Metallurgical Congress.

The Wembley Exhibition Meetings.

THE Empire Mining and Metallurgical Congress was held at the British Empire Exhibition, Wembley, from June 3rd to 6th inclusive, the convening bodies being the seven mining and metallurgical institutions of Great Britain. One of the chief objects was the constitution of an Empire Council of Mining and Metallurgical Engineering Institutions.

Apart from social functions, &c., and the address of the president, Viscount Long of Wraxall, on "Mineral Resources and their Relation to the Prosperity and Development of the Empire," some 34 papers were submitted for discussion.

Safety in Mining.

A paper dealing with researches on safety problems in mining is divided into seven sections, the first being an introduction by Sir Edward Troup (chairman of the Safety in Mines Research Board), briefly outlining the machinery for research now available in this country. In 1845, Faraday, in his report on the Haswell Colliery Explosion, indicated coal dust as the chief explosive agency—and yet for thirty years from that time the matter was allowed to sleep, and in 1923, nearly eighty years after Faraday's report, the Research Board was organising demonstrations at Eskmeals to convince practical miners of the appalling dangers of coal dust, and to show the imperfection of the best safeguards yet devised against these dangers.

Under various heads, programmes of research are being carried out, or will be taken up in order by the Research Board or its Committees as trained men and funds are available. The ignition of firedamp by a lamp flame is the special province of the Miners' Lamps Committee, which is now approaching the conclusion of its inquiry, and has pointed the way to important improvements of the light-giving power of lamps.

One group of problems relating to firedamp—those relating to its ignition by electrical agents—has been separated by Dr. Wheeler to some extent from the others and made the subject of a distinct group of inquiries. Programmes of research into these matters, which are of growing importance as the use of electric power is extended in mines, have been settled, and with regard to signalling systems, the investigation is now fairly complete. Of much practical importance is the design of fireproof enclosures for electrical machinery; this subject, on account of its immediate importance, is being actively pursued under Dr. Wheeler's direction, and results which appear to be of practical value have been achieved.

Coal-mining Explosives is the subject dealt with by Col. Sir F. L. Nathan, K.B.E., who remarks that in connection with the determination of the power or strength of an explosive a method that emanated originally from Sir J. J. Thomson is being used for dealing with enclosed explosives. It depends upon the fact that, when pressure is applied to a plate composed of tourmaline crystals, an electric charge is generated on the surface of the plate in a degree proportional to the pressure exerted. In applying the test, the tourmaline crystals are screened from the disruptive action of the wave of detonation, and the charge produced is measured by causing it to deflect a beam of cathode rays by electrostatic action.

Spontaneous Combustion of Coal was dealt with by Mr. J. S. Haldane, M.D., F.R.S. (director of the Coal Owners' Mining Research Laboratory, University of Birmingham), who confines himself to the main scientific questions arising in connection with the origin of the spontaneous combustion of coal.

The Explosion of Firedamp was the subject of Prof. H. B. Dixon's paper and *Coal-dust Explosions* was the subject treated of by Mr. W. Mason.

Electricity in Coal Mines.

In dealing with this subject Mr. Robert Nelson points out that already results have been obtained which in their detail and completeness few, if any, of the other sections will be able to parallel. He indicates the obstacles to the use of electricity in mines which have been overcome, partly by what is often called "horse-sense," and partly by scientific research and experiment. So far as can be ascertained the first electric motor to be set to work below ground in a coal-mine was at Trafalgar Colliery, Drybrook, Gloucestershire, in January, 1883. Thirty years later—in 1913—the total h.p. of electrical plant in use underground was 316,667, but by the end of 1923 the total h.p. had reached 753,138, in itself a moderate figure having regard to the total horse-power of all forms of motive power in use in the mines, but it indicates a greatly accelerated rate of growth during recent years.

There is no doubt that this increased rate of growth has been directly due to increased confidence in the safety of electricity, quite apart from its convenience and reliability and the improved design of the apparatus available. Electricity is the perfect medium for distributing power below-ground, practically and economically, but the immediate point of view is that of safety.

Experience indicates two conclusions, both of which are somewhat remarkable: The first is that, taken over a long period, electric shock has caused more than two-thirds of the deaths attributable to the introduction of electricity below-ground, and the second is that until a very neat and clean-cut research solved the problem in 1915, electric-signalling circuits in use at mines were at least as likely to initiate an explosion as the very much heavier current-carrying power and lighting circuits.

Deaths from electric shock below ground during the triennial period 1910 to 1912 numbered 31 or 9.8. per 100,000 h.p of motors installed; during 1913 to 1915 the figures were 25 and 5.3; during 1916 to 1918 they were 12 and 2.2; and during 1919 to 1921 they were 10 and 1.7 respectively.

As regards the dangers of fire and explosion, such accidents as have happened have occurred at very irregular intervals, but taken over the whole period and confining the statement to power and lighting circuits, the sum-total of the loss of life under both heads has been about one-half of the total loss from electric shock. The striking improvement in the standard of safety as regards the risk of electric shock has been mainly due to the common-sense application of improved methods in electrical distribution and the adoption of so-called "ironclad" construction of apparatus used below-ground. A high degree of immunity from certain classes of accidents, with ordinary care, can now be attained. Prof. W. M. Thornton's investigations and research work have not received the recognition they richly deserve. Greater risk was attached to the use of fittings for electric-lighting circuits, to telephone and signalling apparatus, and to all cables used in conjunction with such apparatus than was at first generally realised. The methods which have secured comparative immunity from accident with heavy-current machinery might clearly have been applied, though at considerable expense, to the lighter apparatus, but Prof. Thornton's conclusions remove the need for the added expense whilst providing an improved technical solution of the problem.

Prof. Thornton has been associated with Prof. R. V. Wheeler, of Sheffield University, of whose researches in other important directions the Congress was well aware. In the present situation few, if any, fresh fields of research remain unprospected. Experience may suggest an adjustment here and there, but practically everything is known about the requirements of safety in connection with the different types of apparatus in present use. Prof. Douglas Hay and Mr. I. C. F. Statham recently gave an interesting account of investigations carried out in the Mining Department of the University of Sheffield into the flameproof design of casings for electrical apparatus. All kinds of apparatus were submitted for test—motors, controllers, switches, coal-cutters, gate-end boxes, and cable joint-boxes—and they were able to report as below: "It is satisfactory to record that very few failures have occurred under test; in fact, with one exception, such failures as there were took place under abnormal conditions imposed to determine the limits of safety, so that failure was anticipated." It is not held that no unsatisfactory mining electrical plant is now offered for sale, but it can be said that electrical manufacturers have amply proved their readiness to meet requirements, if and when these are clearly expressed by the coal-mining industry.

The opportunity offered for future research with the object of securing greater safety in connection with the use of electricity in coal mines is at the moment almost non-existent. What *is* desirable is that knowledge already gained should be everywhere applied.

Miners' Safety Lamps.

Miners' Safety Lamps are dealt with by Prof. R. V. Wheeler, both the flame and electric types. Of the latter he says that, although they do not fulfil an important function admirably served by flame-lamps—that of indicating the nature of the atmosphere in which the miner is working—they are in a proper sense "safety" lamps, inasmuch as they afford a high degree of security against the accidental ignition of an explosive mixture of firedamp and air in which they may chance to be placed.

The use of electric hand-lamps has continuously and rapidly increased, as the following statistics show:—

Year.	Number of Electric Lamps in use.
1912	10,727
1915	95,167
1918	156,521
1921	268,538
1923	327,929

Little encouragement is given to any suggestion that the miner might be prepared to accept a heavier lamp if he could obtain a brighter light from it; the reply almost invariably is that the electric hand lamp is already too heavy. Nevertheless there are material advantages to be obtained by making an important increase in the magnitude of the source of light employed by a miner at his work, by increasing it four or five-fold, for example; and it may be that the correspondingly greater weight of such a high candle-power lamp, which almost ceases to be a "hand-lamp," will be acquiesced in though the additional weight necessary to provide, say, 1½

candle-power instead of the nominal 1 candle-power, does not find favour. On the whole, it does not appear that much improvement is possible, so far as their capacity is concerned, in the present methods of construction of secondary batteries of a given size and weight, whether acid or alkaline, when the necessity for general reliability is considered. When determining the design of the lamp, the capacity of the battery and the current consumption of the bulb must be considered together, a fact which many prospective manufacturers have ignored.

The Miners' Lamps Committee has carried out a number of series of trials of batches of bulbs of different current consumption that were made by representative manufacturers, the results of which seem to show that there is some advantage as regards candle-power in a bulb that has a current consumption of 1.20 amperes, as compared with the bulbs of which the current consumption is 0.85 or 1.0 ampere; but the advantage is slight and is discounted by a shorter life and by the consideration that the battery to supply such a bulb must have a high capacity. The pillars of the usual form of hand-lamp cut off a considerable proportion of the light and cast heavy shadows which are held by some investigators to be conducive to nystagmus. "Pillarless" lamps are, therefore, to be recommended. They, moreover, possess the added advantage of inspiring respect for their unprotectedness (which is more apparent than real) to such an extent that the life of the plates, and of the bulbs, of such lamps is appreciably longer, owing to the absence of rough handling, than that of lamps provided with pillars. Electric "cap-lamps" are almost universally employed in the United States of America; but in this country they do not seem to be generally acceptable amongst the miners, although the Nystagmus Committee of the Medical Research Council wishes to encourage their use.

There does not seem much likelihood of improvement, unless a substantial increase in weight is conceded, in the 2-volt miners' electric lamp as regards its light-giving powers.

Supposing, however, that the idea of providing hand-lamps for the personal use of the miner is departed from, and that schemes for universal lighting at the face are considered, there are several directions in which development is possible. Any scheme of universal lighting, and indeed lighting by hand-lamps also, would be greatly aided were the surface to be illuminated white instead of black. It should be possible to do much more than is at present attempted by way of whitewashing underground, and any such attempts would be most beneficial to the eyes of the miner. In this connection the choice of a white stone dust, such as limestone dust, for treating coal-dust, goes a long way towards lightening the roadways.

(To be continued.)

Birmingham Corporation Tenders.

Electrical Manufacturers Criticised.

THERE was a discussion at the Birmingham Corporation meeting last week, on the presentation of the report of the Electric Supply Committee, recommending that application be made to the Electricity Commissioners for sanction to borrow £200,000 required for mains extensions.

Mr. H. K. BEALE, the chairman, moved the adoption of the report, and in doing so he took occasion to refer to quite another matter, an incident which had recently arisen, but which, he said, was not mentioned in the report and he thought would interest the Council. He said that profiteering from which they had all suffered at one time or another, had now crept even into the electrical industry. Two months ago the department wanted some new plant, and it happened there was a firm of contractors who were making almost identical plant for them at the time. There were some slight differences in detail, but substantially it was the same plant. They thought it well, although they had got a contract with these engineers, to test the market, and, accordingly, they put the new contract up for competition. They invited four firms to compete, excluding the present contractors because, of course, they knew their price. Nearly all these big manufacturers of electrical machinery were members of the British Electrical and Allied Manufacturers' Association. It was an ordinary trade association which probably served a useful purpose in looking after the interests of its members, but among other things it seemed to have some control over the prices at which its members tendered for contracts. When the tenders came in the lowest was £9,000 and the highest £9,765. These prices were such an increase on the price at which the department was getting the machinery already on order that it was obvious the four firms were either in a ring by themselves or were being controlled by the association of which they were members.

"Owing to a pure accident—a mistake by a postal clerk in the office—our firm of contractors got to know," said Mr. Beale, "that other people were being invited to tender for machinery similar to that they were making for us at the time. They communicated with us and asked to be allowed to tender. They said 'We are willing to take this as an extra on our existing contract, but we should like to tender as the other people have done if you will permit us.' We said: 'Yes, put your tender in if you like.' They put a tender in having told us that they were willing to regard the new contract as an extra on the old one. Their price, according to their new tender, was £9,360, within the two limits of the other four tenders. The price at which this firm are willing to do this work as an extra on their old contract is £3,615. We are entitled to assume that £3,615, for which this firm are willing to do the work and take on as many more orders as we like to give them, is a fair price, giving a fair return to the manufacturer. What are we to think of an association or a ring that puts up the fair price of £3,615 to £9,000 and over? Even suppose there was no profit at all on the £3,615—which I do not believe, because the manufacturers of electrical machinery are doing pretty well—the bulk of the difference between that and the £9,000 must be all profit. Can you conceive of anything more likely to drive British trade from the country than this? Doesn't it shake one's confidence in the whole system of competitive tenders? We should do better to drop competitive tendering altogether, select a substantial firm, and go and make the best bargain with them that we can. It is an incentive to try and put tenders abroad, or, at any rate, to get competition from abroad. What faith can you have after this in the protestation of contractors that they have contracted at the very rock-bottom price?"

"We hear sometimes that certain industries cannot stand any further burdens in the shape of wages or taxation or what-not. What faith can we have in these protestations now when there is such a margin as this? No harm has been done, because this thing has been found out and exposed. We promptly placed the contract as an extra on the old contract, and we shall get the work done for £3,615. But one wonders how many times we have been had." It was difficult to speak dispassionately in a case like this. Corporation committees and others were working as far as possible to place contracts in this country. What were they to do when they discovered a thing like this? It was difficult to see how a ring or association could hold together where there was such a bare-faced attempt at fleecing the public. As a matter of fact, it had broken down because one of its members had broken out of the ring and expressed its willingness to do the work at the old contract price. When big substantial firms acted in this way they must not be surprised if sooner or later the purchaser happened to find it out and exposed the whole thing. He did not know what the remedy was for the moment. The Government said it was going to bring in a Bill to stop profiteering. In the meantime the Electric Supply Committee was having to go into the whole question of competitive tenders and see if there was no safeguard which it could take for the protection of itself and the Corporation against profiteering like this.

Alderman P. BOWER followed in the same strain. Mr. J. FRYER thought it would be the clear duty of the General Purposes Committee to consider whether all tenders should not be made public. Alderman CADBURY hoped the matter would be taken to the Municipal Authorities' Association. Alderman J. V. STEVENS wondered how far this kind of thing affected other committees of the Council, and Mr. BEALE, in reply, said he did not quite see what good it would have done to have made the tenders public. They had done far better by approaching the original contractors and making a bargain with them while they could get it.

The matter is to come before the next meeting of the Electric Supply Committee.

The London correspondent of the *Birmingham Daily Post* reports that on June 4th he invited the Beama to reply to Mr. Beale's statement. He says:—"The director in charge assured me that 'Beama' knew nothing at all about the particular tenders submitted to the Birmingham Electric Supply Committee. The four firms concerned are members of 'Beama,' but it is not the business of the trade organisation, the director said, to control prices or to regulate tenders. He suggested that the surest way to test an allegation of profiteering by any of these four firms was to examine their respective balance sheets. 'You will find,' he said, 'that their average dividends are about 6 per cent.—scarcely a figure that justifies a charge of unreasonable profiteering.' In another quarter where Mr. Beale's complaint was discussed the suggestion was made that closer inquiry probably would disclose that the quotation of £9,000 odd for this particular contract was not at all out of the way for special gear."

Ceylon's Electrical Imports.

THE following table shows the value of Ceylon's imports of electrical and allied materials during the past year. The figures have been taken from the recently published official returns. The corresponding statistics for 1922 have been added and notes of decrease or increase are also given :—

	1922. Rupees.	1923. Rupees.	Inc. or Dec. Rupees.
Control and switchgear.—			
Total	5,500	22,000	+ 16,500
From United Kingdom ...	5,000	22,000	+ 17,000
,, United States	500	—	— 500
Generators, alternators and dynamos.—			
Total	15,000	322,000	+ 307,000
From United Kingdom ...	14,000	317,000	+ 303,000
,, Germany	1,000	1,000	—
Motors.—			
Total	30,000	38,000	+ 8,000
From United Kingdom ...	20,000	27,000	+ 7,000
,, United States	9,000	8,000	— 1,000
Transformers and converters.—			
Total	—	3,000	+ 3,000
From United Kingdom ...	*	2,000	—
,, United States	*	1,000	—
Magnetos, ignition.—			
Total	1,000	6,000	+ 5,000
From United Kingdom ...	*	1,300	—
,, Germany	*	400	—
,, United States	*	400	—
Electric wires and cables (insulated).—			
Total	163,000	218,000	+ 55,000
From United Kingdom ...	155,000	215,000	+ 60,000
,, United States	4,000	—	— 4,000
,, Germany	—	2,000	+ 2,000
Telegraph and telephone instruments and apparatus.—			
Total	88,000	151,000	+ 63,000
From United Kingdom ...	84,000	146,000	+ 62,000
,, United States	4,000	3,000	— 1,000
Electric lighting accessories and fittings, including switches.—			
Total	125,000	182,000	+ 57,000
From United Kingdom ...	92,000	111,000	+ 19,000
,, Germany	8,000	18,000	+ 10,000
,, United States	13,000	27,000	+ 14,000
,, Holland	—	12,000	+ 12,000
Electrical goods and apparatus not elsewhere specified.—			
Total	191,000	200,000	+ 9,000
From United Kingdom ...	59,000	159,000	+ 100,000
,, Australia	73,000	13,000	— 60,000
,, India	21,000	—	— 21,000
,, Italy	8,000	1,000	— 7,000
,, United States	21,000	14,000	— 7,000
,, Germany	—	7,000	+ 7,000
Electrical machinery not elsewhere enumerated.—			
Total	183,000	80,000	— 103,000
From United Kingdom ...	149,000	38,000	— 111,000
,, Germany	7,000	12,000	+ 5,000
,, United States	21,000	22,000	+ 1,000
,, Holland	—	4,000	+ 4,000
Machinery belting, leather.—			
Total	78,000	67,000	— 11,000
From United Kingdom ...	60,000	62,000	+ 2,000
,, India	18,000	5,000	— 13,000
Machinery belting, other than leather.—			
Total	298,000	282,000	— 16,000
From United Kingdom ...	288,000	278,000	— 10,000
,, India	9,000	1,000	— 8,000

* Not specified.

NOTE : Rs.10 = £1.

Parliamentary.

[By Our Special Parliamentary Reporter.]

Radio Research.—On June 3rd, Mr. HARTSHORN informed Mr. BAKER that the following Government departments undertook radio research :—The Admiralty, War Office, Air Ministry, General Post Office, and the Department of Scientific and Industrial Research. The first four also maintained radio services. Research, so far as it was not solely of interest to the Service Departments, was co-ordinated by the Radio Research Board of the Department of Scientific and Industrial Research, on which all the above departments were represented, while the services conducted by the Service Departments and the General Post Office were co-ordinated by the Imperial Communications Committee. The further co-ordination of these activities was at present under the consideration of that Committee.

Severn Barrage Scheme.—On June 3rd, in reply to Mr. COMYNS CARR, Mr. S. WEBB, the President of the Board of Trade, said that no specific Severn barrage scheme was being investigated, but an informal and preliminary committee, consisting of Sir John Snell, Chairman of the Electricity Commissioners, Prof. A. H. Gibson, and Mr. Maurice F. C. Wilson, was advising the Board of Trade as to the manner in which the whole problem could be best and most expeditiously investigated.

Electricity (Supply) Acts (1882 to 1922) Amendment Bill.—On June 4th, Mr. P. HARRIS asked leave to bring in a Bill to increase the powers of Joint Electricity Authorities. The Act of 1922 made no provision for compulsion, without which no electrical authority could hope to operate successfully. His Bill was a short one; it provided merely for the restoration of the principle of the power of compulsion which was provided for in the original Bill.

Sir J. WALL opposed the introduction of the Bill. Leave was, however, granted, and the Bill was introduced and read a first time.

Post Office Cables.—On June 5th, Mr. HARTSHORN informed Mr. BAKER that the Post Office owned the cables between this country and Norway and Russia. It also provided telegraphic communication *via* Germany with the Eastern Baltic States, and carried on a limited radio service with some of those States. The Danish Great Northern Telegraph Co. was formerly entitled to carry all telegrams for Denmark, Sweden and Northern Russia handed to the Post Office by senders without any indication of route, subject to its route being as efficient as any other, but those preferential rights expired last year. Seventeen telegraph and telephone cables connected Great Britain with France, fourteen of which were jointly owned by the British and French Governments. The remaining three were telegraph cables owned by transatlantic cable companies, the use of which was restricted to the transmission of traffic to and from America and places beyond.

L.C.C. Tramways.—On June 5th, during a debate on the second reading of the London County Council (Money) Bill, Sir CYRIL COBB, replying on behalf of the Council to criticism of the tramway system, said that this year all their tramway schemes save one—£45,000 to run tramcars over Southwark Bridge—had failed to get through. The actual expenditure on capital account this year was to meet the charges for the new turbo-generator and the new coal-bunkers at Greenwich and the reconstruction of the Elephant and Castle sub-station. The L.C.C. was scrapping many of the old and inefficient tramcars and replacing them by new ones. He contended that the tramways were paying their way and by 1938 only £2,000,000 would be left to pay off.

The Bill was read a second time.

Electricity Supply by Gas Companies.—A Bill has been introduced in the House of Commons to facilitate the supply of electricity by statutory gas companies, authorising them to apply for Special Orders under the Electricity Supply Acts, and to carry into effect the powers granted by the Orders, and authorising the Electricity Commissioners to grant to such companies which have obtained powers to supply electricity Special Orders empowering them to raise capital for the purpose.

Correspondence.

Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Overload Protection by "Z"-connected Relays.

With reference to the letters appearing in last week's issue *re* my article on Z-connected relays, I beg to reply as follows: If Mr. Barfield will take the vector sum of the currents in the three phases, as shown in his diagram, he will find that it is not zero, and consequently there must be a considerable leakage to earth. Such being the case, it is obviously advantageous for one relay to operate, and so in circumstances like this the Z method of connection is even superior to the ordinary straight method.

June 3rd, 1924. W.

Pulverised Coal.

It is intensely interesting to me to see the growth of interest now being taken in the pulverised fuel developments. My introduction to this system of firing boilers was during the time I was in the United States, and it was in connection with the "Bettington" boiler. It seems to me that the boiler makers are still not taking steps to ensure the best conditions for burning pulverised fuel. The "Bettington" boiler is designed for this purpose especially, and one would therefore think would be correctly proportioned, but unfortunately the cause for many of the troubles in the use of pulverised fuel is still to be found principally in boiler furnace design.

What are the troublesome conditions met with in the combustion of the fuel?—

(1) Difficulty in obtaining firebricks to resist the high temperature and scouring of the flame.

(2) Deposition of the ashes or burnt dust.

To minimise these troubles the first and most important thing to do is to make the combustion chamber exceedingly large, so that the velocity of the hot gases is reduced to a minimum, the velocity of the gases through the tube spaces being as usual. The flue openings also must be made very large. No boiler fitted for burning pulverised fuel has a combustion chamber nearly large enough; even the Bettington boiler as now designed is very much lacking in this respect, and Babcock & Wilcox are in the same box. Simon-Carves and Herbert, Ltd., are increasing the combustion chambers, but in other respects are wanting, and though the boiler makers have been forced from time to time to increase the size of the combustion chambers of their boilers they still do not go far enough. It has been a source of wonder to me that they do not work from the other direction, namely, from if anything too large a combustion chamber instead of from too small a one, but no doubt competitive costs control the matter; but as the development of pulverised fuel is of such importance, I do not think the old designs of boilers should be the cause of checking its growth, which they will have the effect of doing, if the manufacturers advocate the adaptation of such plant to existing boilers now hand-fired or automatic.

It must not be overlooked that the development of pulverised fuel in the States was the result of requiring large powers concentrated in big power houses, and as the coal contained a high percentage of moisture, a large percentage of ash, and was very friable, with a low calorific value, and had a sensible percentage of sulphur, together with the difficulty of storing it in adequate quantities with safety, we can see at once the advantages of pulverising. But even with all these coal disadvantages, and after a careful test, what was the result of a report made by one of the biggest users of this type of fuel? He says that: "He did not believe that under test conditions over a period of constant boiler rating the efficiency obtained with the use of pulverised fuel would exceed that which had been obtained from the best stoker practice under similar operating conditions."

I do not quote this in any way to cause would-be users to refrain from adopting pulverised coal, but to indicate that they should give the question careful consideration, and it would be perhaps wise to obtain advice on any such proposition, not tainted with the element of the manufacturer or seller behind it.

I have always believed in the possibilities of so handling very low-grade coal and possibly the anthracite duff dump.

There are one or two matters that should be carefully considered:—

(1) It would be most efficient if the combustion chamber could be contained within a ring or as nearly as possible a ring of tubes.

(2) The flame should, I think, preferably be directed downward.

(3) At or near the end of the flame, jets of steam should be projected in a downward direction to cool the ash and precipitate it.

(4) Possibly an outer row of pipes contained within fire-clay blocks could be used as feed-water heaters.

The present device of building combustion chambers projecting beyond the boilers is only a make-shift to use present designs of boilers. I have read with interest an article by Mr. W. D. Wylde, but his analysis is principally based upon the comparative results obtainable by burning steam coal on chain-grate stokers, as against using the same coal pulverised. This is not the principal object in view as I understand it. The principal object is, it seems to me, to make use of coals that cannot now be satisfactorily used for steam-raising purposes, such as bastard anthracite, dry steam smalls, duff, &c. In the same issue of your paper there is another article by Mr. G. P. Dennis, M.I.E.E., but it seems to me more or less an extract from catalogues or pamphlets published by the various makers of pulverised fuel apparatus. No doubt it all helps to increase the interest in this subject.

A very much greater saving in fuel, I believe, can be made by using pulverised fuel for muffle furnace work, annealing furnaces, reheating furnaces and soaking pits, and I should think, in open-hearth furnaces. But in the above cases fuels with different characteristics would be needed, especially for the reheating and open-hearth furnaces, and possibly although not so important in some forms of annealing furnaces. There should, I think, be a great future for pulverised coal for these operations, which work night and day and with a steady and regular consumption hour by hour.

J. E. Stewart, M.I.E.E., M.INST.C.E.

Swansea, *May 13th*, 1924.

Testing of Electrical Material in Sweden.—At a meeting of Svenska Elektricitetsverksfoereningen held at Karlstad, it was proposed to create an institution for testing material for electrical installations with the object of excluding any foreign material not reaching the required standard.—*Reuter's Trade Service* (Stockholm).

Legal.

British Thomson-Houston Litigation.

A MOTION for judgment in the action by the British Thomson-Houston, Co., Ltd., *v.* George & Jobling, which had reference to the plaintiffs' incandescent electric lamp patents, and alleged infringements by the defendants, was before Mr. Justice Romer in the Chancery Division on June 6th.

Counsel for the plaintiffs, however, asked for the motion to be struck out because he said the plaintiffs' Newcastle branch had accepted a certain undertaking from the defendants, in consideration of which the plaintiffs did not propose to press the matter further.

THE case of the British Thomson-Houston Company, Ltd., against the Star Lamp Company, came before the Court of Appeal, consisting of the Master of the Rolls and Lord Justice Atkin, on June 6th, upon the application of the defendants, who carried on business as the Star Lamp Company, for an extension of time within which to appeal from a judgment of Mr. Justice Tomlin in the Chancery Division.

Mr. HUGH FLETCHER MOULTON, in support of the application, stated that the defendant, who was a small vendor of lamps, had the action brought against him by the plaintiff company for the alleged infringement of its drawn wire patent. Before the action was heard, according to defendants' evidence, the plaintiffs refused to allow the case to abide the result of the appeal of the British Insulated and Helsby Cables, Ltd., from the judgment of Mr. Justice Russell. The result was that the defendants, who appeared in person, had to submit to judgment. On June 2nd, the Court of Appeal delivered its reserved judgment upon the appeal of the Helsby Company against the judgment of Mr. Justice Russell and the appeal was allowed and the plaintiff company's patent of 1909 held to be invalid. The defendant now wished to appeal from the judgment of Mr. Justice Tomlin; but as the time for appealing expired on May 23rd, the present application was necessary.

LORD JUSTICE ATKIN: That was whilst our judgment was under consideration. If we had given our judgment at once the defendant would have been in time.

Mr. TREVOR WATSON opposed the application on behalf of the British Thomson-Houston Company. He said that when before Mr. Justice Tomlin the defendant did not go into the witness-box, did not cross-examine on any matter raised in the pleadings, and did not contest the validity of the patent. What he said was that he was an innocent infringer.

In the result their Lordships granted the application, subject to the defendant's paying the costs of it and undertaking to set down the appeal within three weeks.

British Thomson-Houston Co., Ltd., v. British Insulated and Helsby Cables, Ltd.

JUDGMENT OF THE COURT OF APPEAL.

THE following is a summary of the very long judgment read by the Master of the Rolls in the Court of Appeal on June 2nd, briefly reported in our last issue.

His LORDSHIP first reviewed the history of the case, in which Mr. Justice Russell on January 28th, 1924, decided in favour of the plaintiffs, and dismissed the counterclaim for revocation of the letters patent. He explained that the plaintiffs were the owners of the patent No. 21,513 of 1906, which was the subject of an action brought by them against Duram, Ltd., in 1913; Mr. Justice Astbury in 1916 decided that the patent was invalid on the ground that claim 1 was too wide, and this decision was upheld by the Court of Appeal in 1917 and the House of Lords in 1918. Having failed to establish the 1906 patent, the plaintiffs fell back on their patent No. 23,499 of 1909, and the present action charging infringement was heard before Mr. Justice Russell towards the end of 1923. The plaintiffs also took proceedings in Scotland to establish the validity of the same patent (1909) against Messrs. Charlesworth Peebles & Co. in 1922, before Lord Blackburn, who on July 19th, 1923, gave judgment in favour of the pursuers; an appeal to the Inner House was dismissed on March 15th, 1924, by the Lord President and Lords Cullen and Sands, Lord Skerrington dissenting.

The present respondents had altered their position from that taken up in September, 1913. They were entitled at law to do so. The question before the Court of Appeal was whether Mr. Justice Russell was right in upholding the validity of the 1909 patent and accepting the view, now presented by the respondents, that the 1906 patent taught little in the knowledge of the art, and did not anticipate the 1909 patent. Indeed the respondents went further: they now said that the 1906 patent misled the public along a road that was not destined to reach success, however much they themselves, in attachment to it, might have attempted at one time blindly to lead the blind. The Master of the Rolls examined in detail the issues raised, and the decisions given, upon the 1906 specification in the action against Duram, Ltd.; Mr. Justice Astbury held that in effect the plaintiffs claimed a principle, and that the first claim was bad for want of subject matter, and that the patent as it stood was invalid. The Court of Appeal and the House of Lords agreed, but Lord Dunedin dissented.

In the present action, infringement of the 1909 specification was charged against the defendants, and the main issue was the defence of want of novelty and anticipation. As the respondents alleged that the specification of 1906 was absolutely misleading, and that that of 1909 contained the invention which could never have been reached if the path indicated in 1906 had been followed, his Lordship said it was necessary to examine both specifications with some care. He said it was admitted that the former contained a root principle which was the foundation of the industry in drawn tungsten wire, namely, to work it hot; and that that was a considerable discovery. What was impossible before became feasible; tungsten was no longer intractable but ductile. Stress had been laid on "the warning passage" which, the respondents claimed, indicated a temperature of dull red—say, 600 or 650 degrees—and no higher as the temperature for working, whereas as now known, from 1909 and thereafter, a much higher temperature was needed in the course of the production of a filament. He could not accept that interpretation; he could not find a general indication that dull red was the temperature beyond which they must not go. In this he agreed with Lord Finlay. In his judgment the 1906 specification recorded a definite discovery in that tungsten could be worked hot and that working it when hot increased its ductility. His view was supported by the fact that the witness Murdoch, a practical wire drawer, told to work under the 1906 specification, used temperatures up to 1,170 degrees. There was evidence that that specification did afford a practical system of producing ductile tungsten; he accepted that evidence, and rejected the view that the 1906 specification was unworkable, unproductive, and useless. Was it an anticipation of the patent now sued on? That was the question to be decided. His Lordship then turned to the 1909 specification and examined it in detail. A passage in this, he said, recorded the discovery that the very processes shown in 1906, which embodied repeated mechanical working of tungsten while hot, "yield tungsten which is ductile at ordinary temperature." Amongst the claims he found none for a process new and unknown before. There were references to ductility at ordinary temperatures; but ductility was secured by the 1906 process; its existence at ordinary temperatures was not secured by a new process of 1909. His Lordship proceeded to discuss the judgment given in the Scottish Courts, with which he disagreed; there appeared to him, as to Lord Skerrington, to be one invention revealed in 1906 to which a further discovery was attached in 1909 by insistence upon the quality of ductility cold, which was as much inherent in, and belonged to, tungsten treated under the process of 1906. Ductility cold could not be held to be an invention due to the 1909 specification. In his Lordship's judgment there was an anticipation by the specification of 1906 of what, it was now suggested, was the invention disclosed by that of 1909. The appeal must be allowed. Judgment must be entered for the defendants upon the claim in the action with costs there and below.

LORD JUSTICE SARGANT also read a long written judgment allowing the appeal, previously stating that Lord Justice Atkin agreed with that judgment.

Sir DUNCAN KERLY, K.C., applied on behalf of the appellants for an order under their counterclaim for revocation of the 1909 patent, and contended that notwithstanding the fact that the Attorney-General had not given his *fiat* at the date when the counterclaim was launched, the appellants were entitled to the order.

Sir ARTHUR COLEFAX, K.C., on behalf of the respondents, opposed the order for revocation upon the ground that the proper practice had not been followed.

After considerable discussion, their Lordships held that the order of revocation was properly constituted, but directed that the operation of that order should be stayed pending an appeal by the British Thomson-Houston Co. to the House of Lords from the judgment of that Court (the Court of Appeal).

Bryan v. Day.

AT the Wandsworth County Court on June 2nd, plaintiff was awarded £35 damages and costs for personal injuries sustained through a brick being dislodged from the roof and falling upon her shoulder while an aerial was being taken down from defendant's premises.

Fraudulent Use of Electricity.

AT the Kingston-on-Thames County Court recently, Col. Wm. Beale was summoned by the Wimbledon Corporation for the fraudulent use of electricity. Mr. G. S. Hall, an electrical contractor, was summoned for aiding and abetting the first defendant. The prosecutor stated that a standard lamp was found to have been connected by means of a plug and socket to a power circuit. Col. Beale said that he knew that he was in the wrong, but he had only used the lamp three or four times; he blamed the contractor for fixing the plug to the power circuit. The Corporation, it was said, did not think that the defendant had been guilty of deliberate fraud. He was fined 5s., and ordered to pay costs amounting to three guineas. The summons against Mr. Hall was dismissed.

Published Specifications.

Compiled expressly for this journal by Patent Agents.

The name of the applicant's patent agent, if any, will be found on the printed specification.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

30,742. "Signalling receiving systems, particularly wireless receiving systems." J. Scott-Taggart and Radio Communication Co., Ltd. November 10th, 1922. (215,798.)

30,744. "Electric signalling systems, particularly wireless receiving systems." J. Scott-Taggart and Radio Communication Co., Ltd. November 10th, 1922. (215,799.)

1923.

4,284. "Sparking plugs." Sir W. Peck. February 13th, 1923. (215,832.)

4,347. "Automatic trip mechanism for electric circuit-breakers." A. H. Railing, H. C. Turner, and A. E. Angold. February 14th, 1923. (215,836.)

4,474. "Electric switches." D. R. Davies and Metropolitan-Vickers Electrical Co., Ltd. February 15th, 1923. (215,836.)

4,562. "Control of the conditions of operation of electric motor generator sets." E. I. David. February 16th, 1923. (215,839.)

4,815. "Electric starting motor gearing for internal-combustion engines." "Scintilla." February 23rd, 1922. (193,840.)

4,817. "Telephone receivers." Sterling Telephone & Electric Co., Ltd., and A. E. Hearne. February 19th, 1923. (215,850.)

5,690. "Portable electric lamps." R. C. Kay. February 27th, 1923. (Addition to 202,384.) (215,870.)

5,722. "Electric conductors." Fuller's United Electric Works, Ltd., and L. Fuller. February 27th, 1923. (215,873.)

5,881. "Storage battery containers." Canadian Battery Container Corporation, Ltd., and J. M. Ahlgren. February 28th, 1923. (215,877.)

6,601. "Electric battery cells and the process of manufacture of same." R. Oppenheim. March 7th, 1923. (215,887.)

6,905. "Apparatus for testing sparking plugs." T. H. J. Watts and R. H. Balston. March 9th, 1923. (215,891.)

6,921. "Device for audibly indicating whether an electric light is in or out." A. Shaw and F. Fairer. March 10th, 1923. (215,892.)

7,317. "Means for introducing capacity effects in alternating electric current systems and apparatus." A. F. Wall. March 14th, 1923. (215,897.)

7,350. "Magnetic blow-out devices for electric circuit-interrupters and the like." N. E. North and Metropolitan-Vickers Electrical Co., Ltd. March 14th, 1923. (215,899.)

7,458. "Electrical contacts for weighing scales." Automatic Scale Co., Ltd., and E. L. Blick. March 15th, 1923. (215,905.)

8,229. "Variable electric condensers, more particularly for use in wireless telegraphy and telephony." A. E. Chapman and L. H. Wadsworth. March 22nd, 1923. (215,906.)

10,040. "X-ray apparatus." W. H. Coleman. April 13th, 1923. (215,938.)

11,370. "Crystal-holder for use in wireless systems." B. R. Simmons. April 27th, 1923. (215,944.)

11,578. "Mechanism for impelling pendulums for electric clocks." C. Broughall. April 30th, 1923. (215,947.)

13,576. "Protective devices for alternating-current systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 22nd, 1923. (215,965.)

13,970. "Telephone receivers." J. W. Hobley. May 28th, 1923. (215,971.)

14,372. "Transformation of current on electric railways and tramways." Sir P. Dawson and F. W. Fawdry. May 31st, 1923. (215,980.)

14,885. "Electromagnetic induction micrometers." J. M. Ford. June 7th, 1923. (Addition to 166,317.) (215,986.)

16,003. "Dash-board lamps for motor or other vehicles." J. Desar. June 20th, 1923. (215,995.)

16,400. "Electrical contact devices." A. West & Co., Ltd., and G. Fry. June 25th, 1923. (215,998.)

17,872. "Electric speed, current, and voltage indicating apparatus for motor vehicles and the like." British Thomson-Houston Co., Ltd., A. P. Young, and L. Griffiths. July 10th, 1923. (216,008.)

19,306. "Electrical control systems and apparatus." Westinghouse Electric and Manufacturing Co. July 27th, 1922. (201,568.)

19,938. "Continuously loaded signalling conductors." Western Electric Co., Ltd. August 3rd, 1922. (201,931.)

20,172. "Receiving apparatus for high-frequency oscillations for use in wireless telegraphy and telephony." Funktechnische Ges. August 28th, 1922. (202,978.)

20,744. "Continuously loaded submarine cables." Western Electric Co., Ltd. February 7th, 1923. (211,095.)

21,054. "Signalling systems." Western Electric Co., Ltd. August 10th, 1922. (202,656.)

21,413. "High-frequency telegraphic and telephonic systems." Soc. Française Radio-Electrique. August 24th, 1922. (202,998.)

24,861. "Electrical condensers." Telephone Manufacturing Co., Ltd., and L. F. Barnes. October 5th, 1923. (216,038.)

28,301. "Electric regulating systems." British Thomson-Houston Co., Ltd. February 10th, 1923. (211,100.)

28,373. "Systems of control for dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). November 10th, 1923. (216,054.)

30,634. "Casings for electrical regulators, motor-starters, and like control gear." R. H. Barbour and J. R. Walton. December 5th, 1923. (216,066.)

32,131. "Pins of electrical socket-plugs and the like." C. Skuller. December 21st, 1923. (216,062.)

1924.

208. "Electrical insulating coatings." Metropolitan-Vickers Electrical Co., Ltd. June 5th, 1923. (209,421.)

7,138. "Inductance coils." K. von Wysiecki. August 1st, 1923. (216,077.)

Cardiff Electric Café.—It will be recalled that the Electric Café in St. Mary Street, Cardiff, was started by a number of South Wales engineers with the object of demonstrating to the public how nice electrically-cooked food tastes, showing what electric cookers look like, how they work, and to bring before their notice the latest types of lighting fittings, heaters, and other electrical comforts. In order to make the Café more widely known the E.D.A. has drafted circular letters and publicity cards, which can be used as postcards by those interested for distribution to their friends and clients, together with a plan of the B.E.E. at Wembley indicating the E.D.A. exhibit, &c.

In the present action, infringement of the 1909 specification was charged against the defendants, and the main issue was the defence of want of novelty and anticipation. As the respondents alleged that the specification of 1906 was absolutely misleading, and that that of 1909 contained the invention which could never have been reached if the path indicated in 1906 had been followed, his Lordship said it was necessary to examine both specifications with some care. He said it was admitted that the former contained a root principle which was the foundation of the industry in drawn tungsten wire, namely, to work it hot; and that that was a considerable discovery. What was impossible before became feasible; tungsten was no longer intractable but ductile. Stress had been laid on "the warning passage" which, the respondents claimed, indicated a temperature of dull red—say, 600 or 650 degrees—and no higher as the temperature for working, whereas as now known, from 1909 and thereafter, a much higher temperature was needed in the course of the production of a filament. He could not accept that interpretation; he could not find a general indication that dull red was the temperature beyond which they must not go. In this he agreed with Lord Finlay. In his judgment the 1906 specification recorded a definite discovery in that tungsten could be worked hot and that working it when hot increased its ductility. His view was supported by the fact that the witness Murdoch, a practical wire drawer, told to work under the 1906 specification, used temperatures up to 1,170 degrees. There was evidence that that specification did afford a practical system of producing ductile tungsten; he accepted that evidence, and rejected the view that the 1906 specification was unworkable, unproductive, and useless. Was it an anticipation of the patent now sued on? That was the question to be decided. His Lordship then turned to the 1909 specification and examined it in detail. A passage in this, he said, recorded the discovery that the very processes shown in 1906, which embodied repeated mechanical working of tungsten while hot, "yield tungsten which is ductile at ordinary temperature." Amongst the claims he found none for a process new and unknown before. There were references to ductility at ordinary temperatures; but ductility was secured by the 1906 process; its existence at ordinary temperatures was not secured by a new process of 1909. His Lordship proceeded to discuss the judgment given in the Scottish Courts, with which he disagreed; there appeared to him, as to Lord Skerrington, to be one invention revealed in 1906 to which a further discovery was attached in 1909 by insistence upon the quality of ductility cold, which was as much inherent in, and belonged to, tungsten treated under the process of 1906. Ductility cold could not be held to be an invention due to the 1909 specification. In his Lordship's judgment there was an anticipation by the specification of 1906 of what, it was now suggested, was the invention disclosed by that of 1909. The appeal must be allowed. Judgment must be entered for the defendants upon the claim in the action with costs there and below.

LORD JUSTICE SARGANT also read a long written judgment allowing the appeal, previously stating that Lord Justice Atkin agreed with that judgment.

Sir DUNCAN KERLY, K.C., applied on behalf of the appellants for an order under their counterclaim for revocation of the 1909 patent, and contended that notwithstanding the fact that the Attorney-General had not given his *fiat* at the date when the counterclaim was launched, the appellants were entitled to the order.

Sir ARTHUR COLEFAX, K.C., on behalf of the respondents, opposed the order for revocation upon the ground that the proper practice had not been followed.

After considerable discussion, their Lordships held that the order of revocation was properly constituted, but directed that the operation of that order should be stayed pending an appeal by the British Thomson-Houston Co. to the House of Lords from the judgment of that Court (the Court of Appeal).

Bryan v. Day.

AT the Wandsworth County Court on June 2nd, plaintiff was awarded £35 damages and costs for personal injuries sustained through a brick being dislodged from the roof and falling upon her shoulder while an aerial was being taken down from defendant's premises.

Fraudulent Use of Electricity.

AT the Kingston-on-Thames County Court recently, Col. Wm. Beale was summoned by the Wimbledon Corporation for the fraudulent use of electricity. Mr. G. S. Hall, an electrical contractor, was summoned for aiding and abetting the first defendant. The prosecutor stated that a standard lamp was found to have been connected by means of a plug and socket to a power circuit. Col. Beale said that he knew that he was in the wrong, but he had only used the lamp three or four times; he blamed the contractor for fixing the plug to the power circuit. The Corporation, it was said, did not think that the defendant had been guilty of deliberate fraud. He was fined 5s., and ordered to pay costs amounting to three guineas. The summons against Mr. Hall was dismissed.

Published Specifications.

Compiled expressly for this journal by Patent Agents.

The name of the applicant's patent agent, if any, will be found on the printed specification.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

30,742. "Signalling receiving systems, particularly wireless receiving systems." J. Scott-Taggart and Radio Communication Co., Ltd. November 10th, 1922. (215,798.)

30,744. "Electric signalling systems, particularly wireless receiving systems." J. Scott-Taggart and Radio Communication Co., Ltd. November 10th, 1922. (215,799.)

1923.

4,284. "Sparking plugs." Sir W. Peck. February 13th, 1923. (215,822.)

4,347. "Automatic trip mechanism for electric circuit-breakers." A. Railing, H. C. Turner, and A. E. Angold. February 14th, 1923. (215,826.)

4,474. "Electric switches." D. R. Davies and Metropolitan-Vickers Electrical Co., Ltd. February 15th, 1923. (215,836.)

4,562. "Control of the conditions of operation of electric motor generating sets." E. I. David. February 16th, 1923. (215,839.)

4,815. "Electric starting motor gearing for internal-combustion engines." "Scintilla." February 23rd, 1922. (193,840.)

4,817. "Telephone receivers." Sterling Telephone & Electric Co., Ltd., and A. E. Hearne. February 19th, 1923. (215,850.)

5,690. "Portable electric lamps." R. C. Kay. February 27th, 1923. (Addition to 202,384.) (215,870.)

5,722. "Electric conductors." Fuller's United Electric Works, Ltd., and L. Fuller. February 27th, 1923. (215,873.)

5,881. "Storage battery containers." Canadian Battery Container Corporation, Ltd., and J. M. Ahlgren. February 28th, 1923. (215,877.)

6,601. "Electric battery cells and the process of manufacture of same." R. Oppenheim. March 7th, 1923. (215,887.)

6,905. "Apparatus for testing sparking plugs." T. H. J. Watts and R. Balston. March 9th, 1923. (215,891.)

6,921. "Device for audibly indicating whether an electric light is in or out." A. Shaw and F. Fairer. March 10th, 1923. (215,892.)

7,317. "Means for introducing capacity effects in alternating electric current systems and apparatus." T. F. Wall. March 14th, 1923. (215,897.)

7,350. "Magnetic blow-out devices for electric circuit-interrupters and the like." N. E. North and Metropolitan-Vickers Electrical Co., Ltd. March 14th, 1923. (215,899.)

7,458. "Electrical contacts for weighing scales." Automatic Scale Co., Ltd., and E. L. Blick. March 15th, 1923. (215,905.)

8,229. "Variable electric condensers, more particularly for use in wireless telegraphy and telephony." A. E. Chapman and L. H. Wadsworth. March 22nd, 1923. (215,906.)

10,040. "X-ray apparatus." W. H. Coleman. April 13th, 1923. (215,

11,370. "Crystal-holder for use in wireless systems." B. R. Simmons. April 27th, 1923. (215,944.)

11,578. "Mechanism for impelling pendulums for electric clocks." Broughall. April 30th, 1923. (215,947.)

13,576. "Protective devices for alternating-current systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 22nd, 1923. (215,965.)

13,970. "Telephone receivers." J. W. Hobley. May 28th, 1923. (215,97

14,372. "Transformation of current on electric railways and tramways." Sir P. Dawson and F. W. Fawdry. May 31st, 1923. (215,980.)

14,885. "Electromagnetic induction micrometers." J. M. Ford. June 7th, 1923. (Addition to 166,317.) (215,986.)

16,003. "Dash-board lamps for motor or other vehicles." J. Dessar. June 20th, 1923. (215,995.)

16,490. "Electrical contact devices." A. West & Co., Ltd., and G. Page. June 25th, 1923. (215,998.)

17,872. "Electric speed, current, and voltage indicating apparatus for motor vehicles and the like." British Thomson-Houston Co., Ltd., A. P. Young and L. Griffiths. July 10th, 1923. (216,008.)

19,306. "Electrical control systems and apparatus." Westinghouse Electric and Manufacturing Co. July 27th, 1922. (201,568.)

19,938. "Continuously loaded signalling conductors." Western Electric Co., Ltd. August 3rd, 1922. (201,931.)

20,172. "Receiving apparatus for high-frequency oscillations for use in wireless telegraphy and telephony." Funktechnische Ges. August 28th, 1922. (202,978.)

20,744. "Continuously loaded submarine cables." Western Electric Co., Ltd. February 7th, 1923. (211,095.)

21,054. "Signalling systems." Western Electric Co., Ltd. August 19th, 1922. (202,656.)

21,413. "High-frequency telegraphic and telephonic systems." Soc. Française Radio-Electrique. August 24th, 1922. (202,998.)

24,861. "Electrical condensers." Telephone Manufacturing Co., Ltd., and L. F. Barnes. October 5th, 1923. (216,038.)

28,301. "Electric regulating systems." British Thomson-Houston Co., Ltd. February 10th, 1923. (211,100.)

28,373. "Systems of control for dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). November 10th, 1923. (216,

30,634. "Casings for electrical regulators, motor-starters, and like control gear." R. H. Barbour and J. R. Walton. December 5th, 1923. (216,056.)

32,131. "Pins of electrical socket-plugs and the like." C. Skuller. December 21st, 1923. (216,062.)

1924.

208. "Electrical insulating coatings." Metropolitan-Vickers Electrical Co., Ltd. June 5th, 1923. (209,421.)

7,138. "Inductance coils." K. von Wysiecki. August 1st, 1923. (216,

Cardiff Electric Café.—It will be recalled that the Electric Café in St. Mary Street, Cardiff, was started by a number of South Wales engineers with the object of demonstrating to the public how nice electrically-cooked food tastes, showing what electric cookers look like, how they work, and to bring before their notice the latest types of lighting fittings, heaters and other electrical comforts. In order to make the Café more widely known the E.D.A. has drafted circular letters and publicity cards, which can be used as postcards by those interested for distribution to their friends and clients, together with a plan of the B.E.E. at Wembley indicating the E.D.A. exhibit, &c.